Early Warning for All
Supported by FengYun Satellites

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National Satellite Meteorological Center

(National Center for Space Weather)

China Meteorological Administration

AOMSUC-13

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Busan, Korea

Hosted by Korea Meteorological Administration

NSMC

CONTENTS

9 FengYun Satellites in orbit

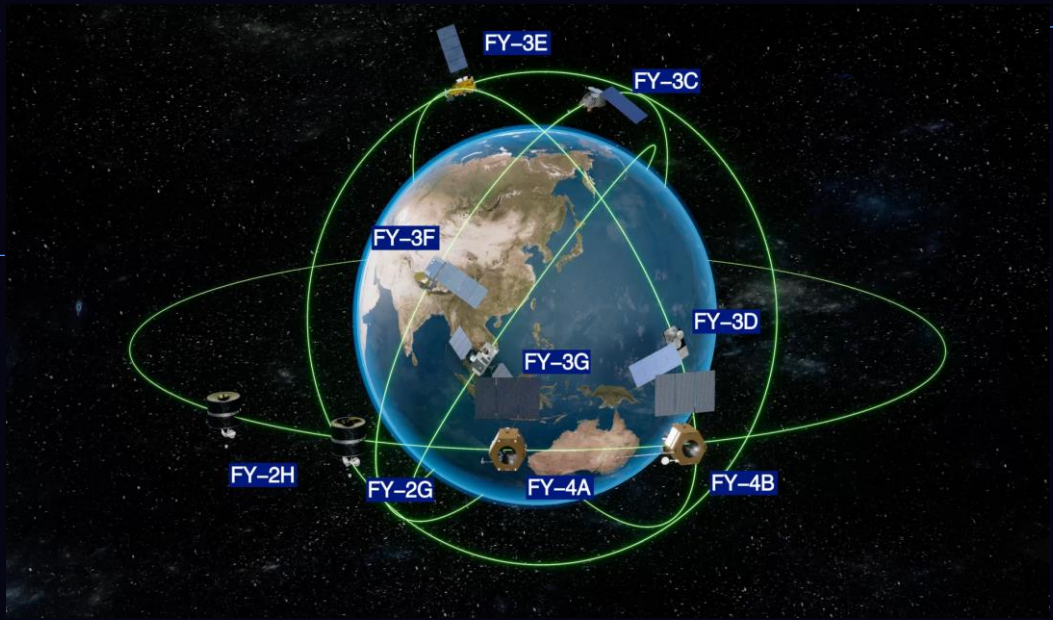
GEO

FY-2G, -2H
FY-2G (99.5°E) and FY-2H (79°E)
Full disk every 30 min
FY-2H, last flight unit of FY-2 series.

FY-4A, -4B
China's second generation GEO meteorological satellites.

FY-4A (104.7°E) , Full disk every 15 min.

FY-4B (133°E), Full disk every 15 min, partial areas rapid scanning at 1 min.



LEO

FY-3C
Mid-morning orbit
Operational with degraded performance

FY-3D
Afternoon orbit,
10 EO instruments

FY-3E
Early-morning orbit
11 EO instruments

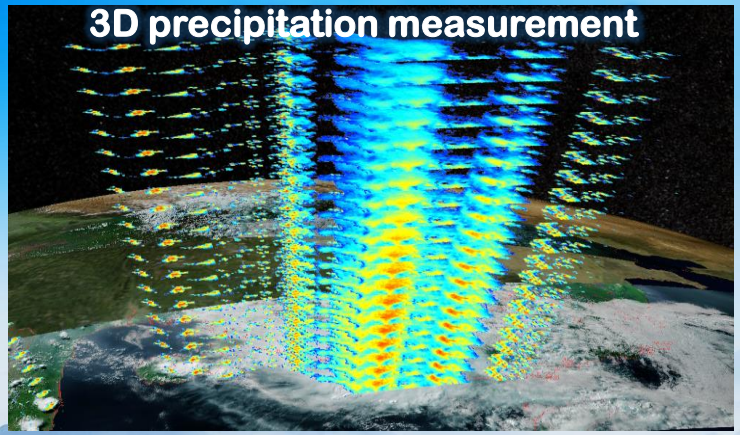
FY-3F
Morning orbit, successor of FY-3C
Launched on August 3, 2023

FY-3G
China's first precipitation measurement satellite, launched on April 16, 2023

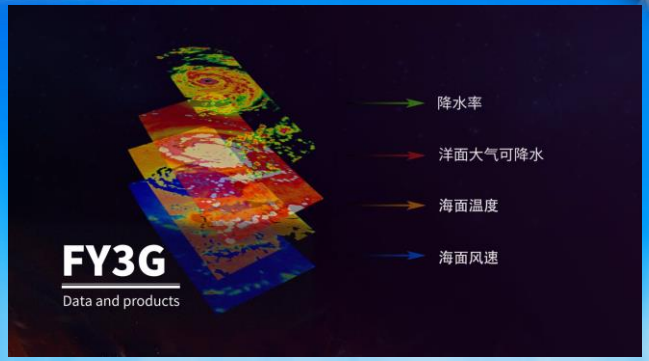
21 satellites, Two generations and Four types

FengYun Constellation – FY-3G

- FY-3G launched on Apr.16,2023 is the first precipitation measurement satellite of the FY-3 series.
- Operates in a 50° inclination orbit, equipped with Ku/Ka-band dual-frequency precipitation measurement radar, and 4 other sensors.
- Measure the 3D structure of precipitation, obtains cloud microphysical parameters.
- Creating an active-passive combined comprehensive FengYun precipitation measurement system.



Demonstration

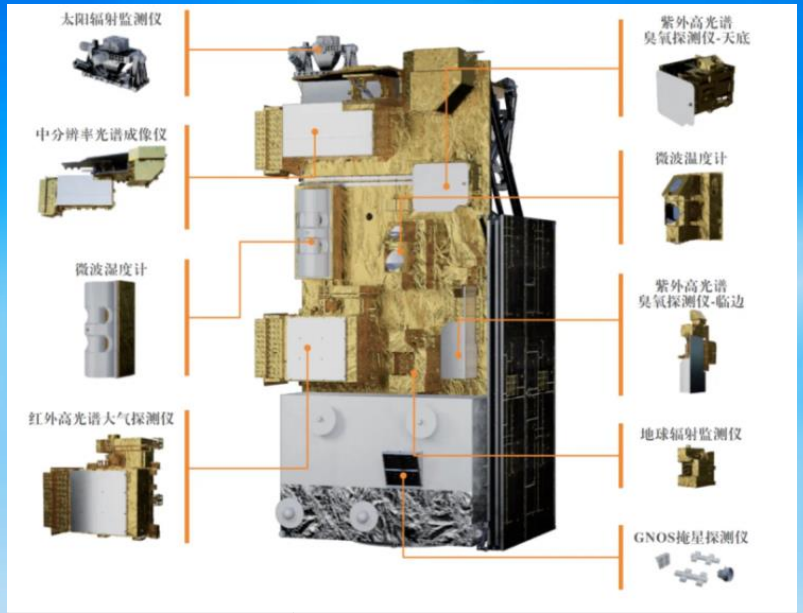


Product Type	Product Name	Instrument Name
Cloud radiation	Cloud detection	MERSI-RM
	Cloud cover	MERSI-RM
	Cloud phase state and cloud type	MERSI-RM
	Cloud top properties (temperature, height, intensity of pressure)	MERSI-RM
Sea/land surface	Land surface temperature	MERSI-RM,MWRI-RM
	Snowdepth/snow water equivalent	MWRI-RM
	Soil moisture	MWRI-RM
	Soil freeze-thaw	MWRI-RM
	Emissivity	MWRI-RM
	Sea surface temperature	MERSI-RM,MWRI-RM
	Sea surface wind speed	MWRI-RM,GNOS-II
Atmospheric parameters	Atmospheric precipitable water	MERSI-RM,MWRI-RM
	Precipitation (surface precipitation, precipitation rate)	MWRI-RM,PMR
	Cloud water content	MWRI-RM
	Atmospheric temperature profile	MWRI-RM
	Occultation atmosphere (atmospheric curvature angle, atmospheric refractive index, atmospheric density, atmospheric temperature and humidity profile)	GNOS-II
	Bright band detection	PMR
	Precipitation type	PMR
	Precipitation phase state	PMR
	Equivalent radar reflectivity factor profile	PMR
	3D raindrop spectral parameter profile	PMR
	3D precipitation rate profile	PMR
	Latent heat	PMR
Space weather	Electron density profile	GNOS-II

FengYun Constellation – FY-3F

- FY-3F launched on Aug.3, 2023 is the newest member of FengYun Constellation with as international advanced load configuration and performance.
- Replace FY-3C’ s duties of providing services in weather forecasting, climate prediction, disaster monitoring, and environmental monitoring.
- Equipped with both microwave and optical instruments, which allows vertical detection of atmospheric temperature and humidity stratification up by over 40 times than previous design.
- Upgraded ultraviolet detection capability, and is equipped with two newly developed ultraviolet hyperspectral remote sensing detectors.

Instrument Payloads



Orbit	Sun-synchronous orbit
Altitude	836 km
ECT	10:00~10:20 desc
Launch	2023-08-03
End of service	≥2031

FengYun GEO Constellation

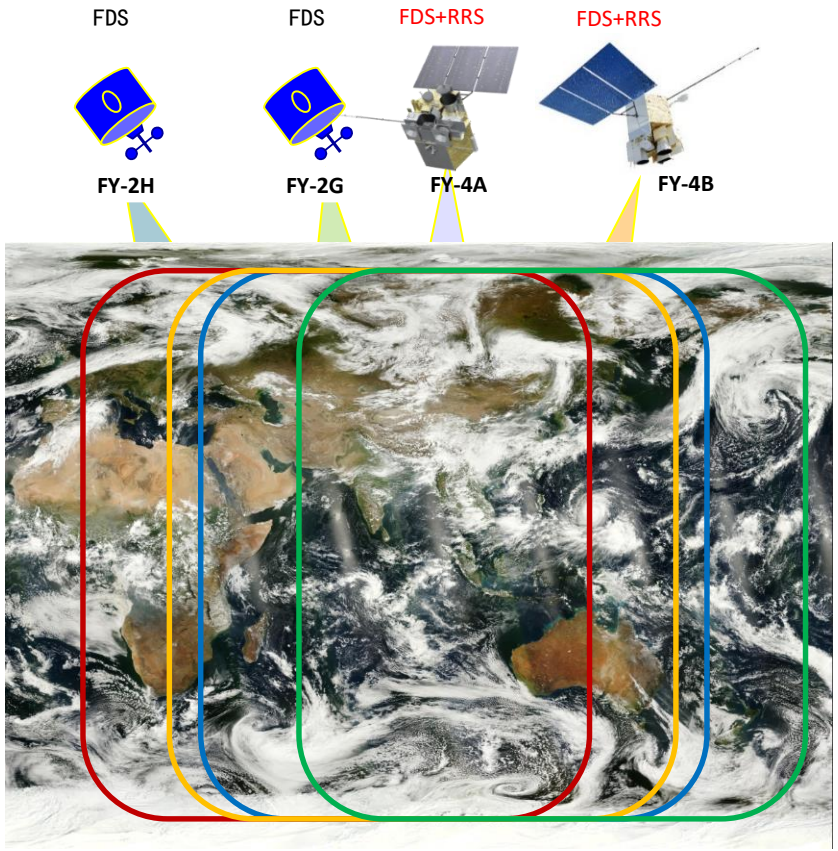
- **4 in operation**

FY-2H：Full Disk (79° E)

FY-2G：Full Disk (99.5° E)

FY-4A：Full Disk + Regional Rapid (105° E)

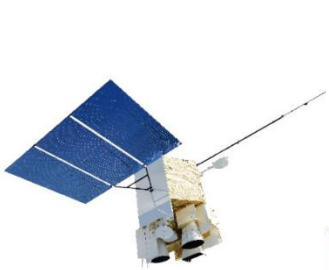
FY-4B：Full Disk + Regional Rapid (133° E)



FengYun GEO Constellation

- FY-4B, the second satellite of FY-4 series, was designed to be **the first operational satellite** of FY-4 series
- Launched on June 3, 2021.

	FY-4A(EXP)	FY-4B(OP)
Stabilization	Three-axis	Three-axis
Designed Life	5~7 Years	7-10 Years
Observation efficiency	85%	85%
Observation Mode	Imaging +Sounding + Lightning Mapping	Imaging +Sounding
Main Instruments	AGRI :14 channels SSP Resolution：0.5~4Km Global imaging：15min Flexible imaging： 2D	AGRI :15 channels SSP Resolution：0.5~4Km Global imaging：15min Flexible imaging： 2D
	GIIRS: SSP Resolution:16Km Spectral Resolution: 0.625cm-1	GIIRS: SSP Resolution:12Km Spectral Resolution: 0.625cm-1
	LMI： SSP Resolution:7.8Km	GHI：7 channels SSP Resolution0.25-2Km
	SEP High energy particles	SEP High energy particles Magnetic field



Space Environment Monitoring Instrument Package (SEP)

Geostationary High-speed Imager (GHI)

Geostationary Interferometric Infrared Sounder (GIIRS)

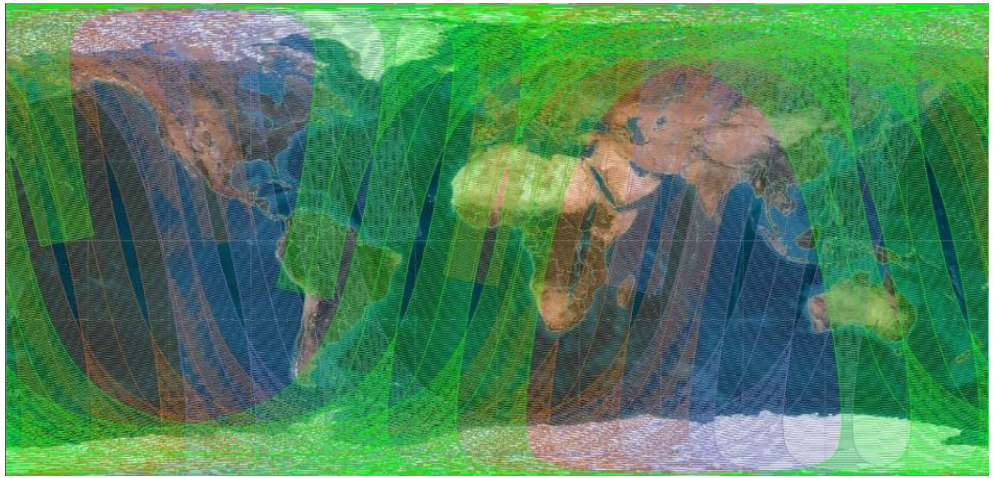
Advanced Geostationary Radiation Imager (AGRI)

http://fy4.nsmc.org.cn/nsmc/en/theme/FY4B.html

FY-3E

- FY-3E is the world's first meteorological satellite in early morning orbit for civil service, filling in the observing gap in early morning.

- Solar X-ray Extreme Ultraviolet Imager (X-EUVI) is the first space solar telescope of China.

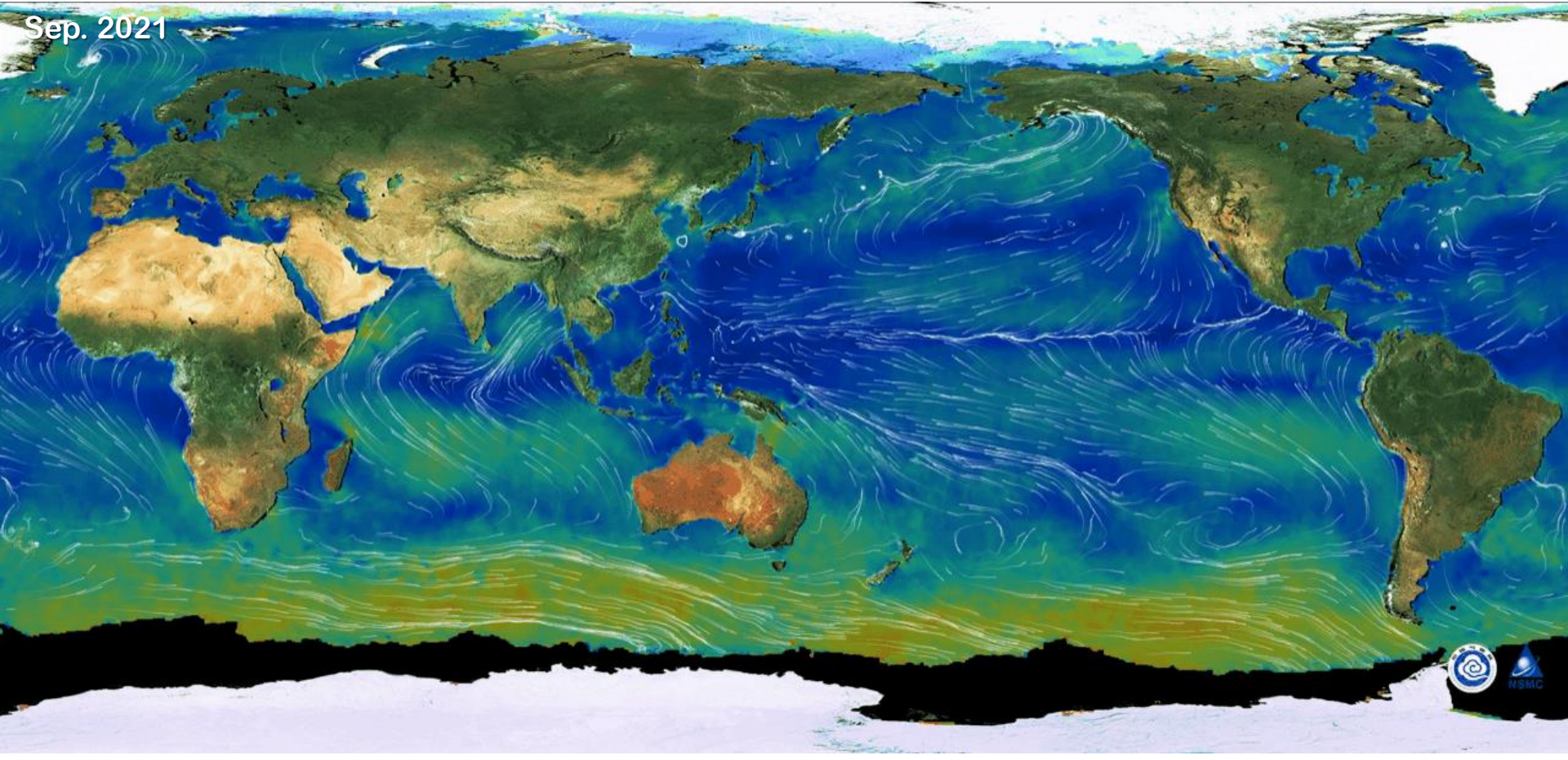


FY-3 Early Morning 6:00 AM Metop-A 9:30 AM NPP 13:30 PM

- Launched on July 5, 2021.

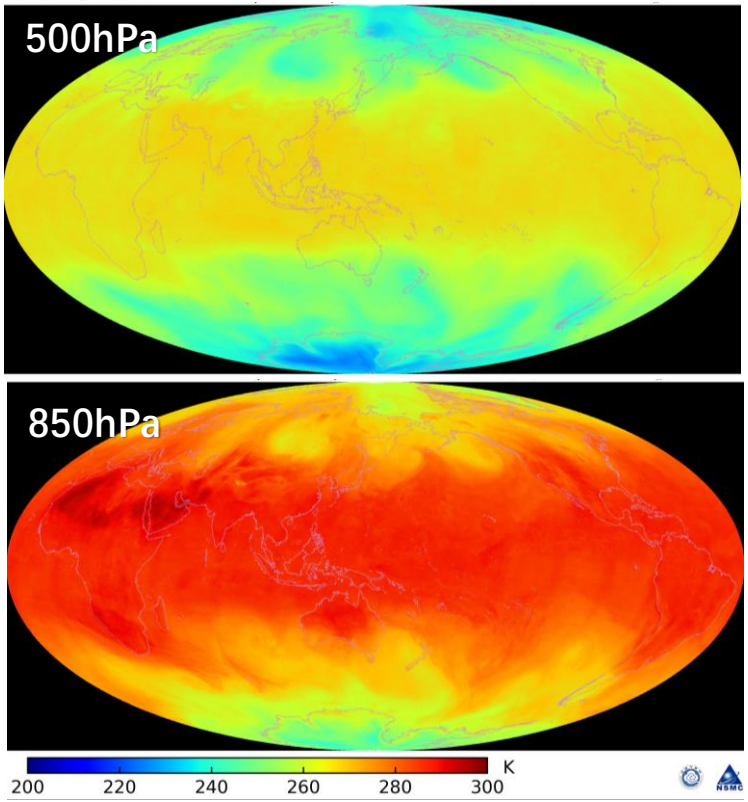
	Satellite Payload	
	Acronym	**Full name**
Improved	GNOS-2	GNSS Radio Occultation Sounder -2
Improved	HIRAS-2	Hyper-spectral Infrared Atmospheric Sounder -2
Improved	MERSI-LL	Medium Resolution Spectral Imager -LL
Successive	MWHS-2	Micro-Wave Humidity Sounder -2
Improved	MWTS-3	Micro-Wave Temperature Sounder -3
Improved	SIM-2	Solar Irradiance Monitor - 2
Completely New	SSIM	Solar Spectral Irradiance Monitor
Improved	SWS/Tri-IPM	SWS / Triple-angle Ionospheric PhotoMeter
Improved	SES/SEM	SES / SEM(FY-3E)
Completely New	WindRAD	Wind Radar
Completely New	XEUVI	Solar X-ray and Extreme Ultraviolet Imager

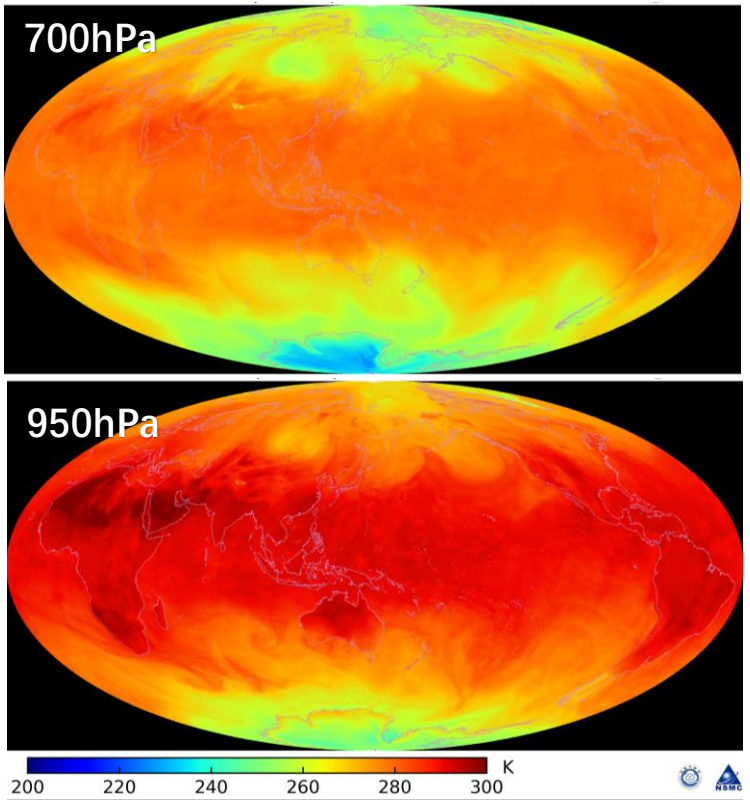
FY-3E Sea surface wind



FY-3E temperature

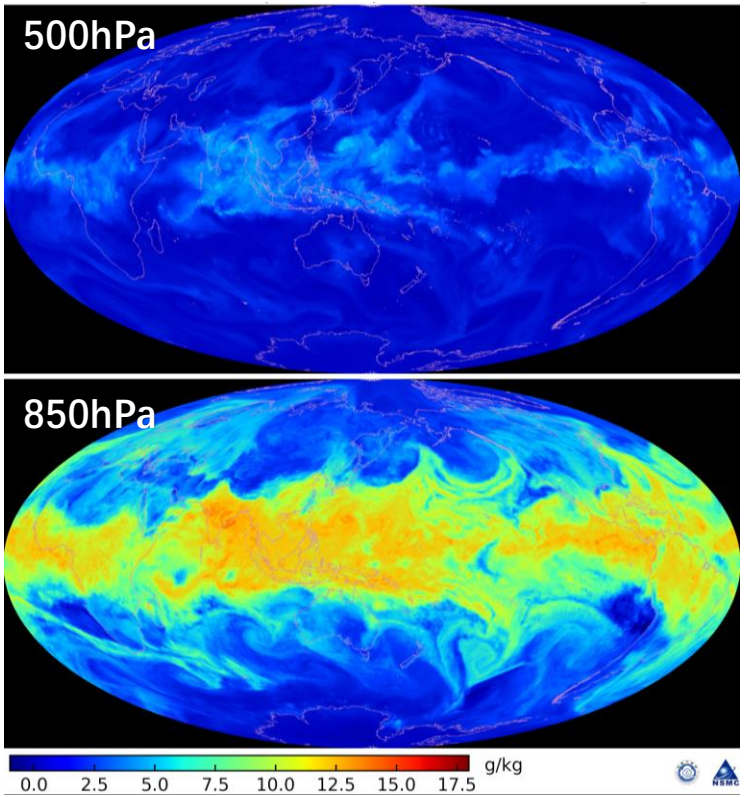
2021.9.27

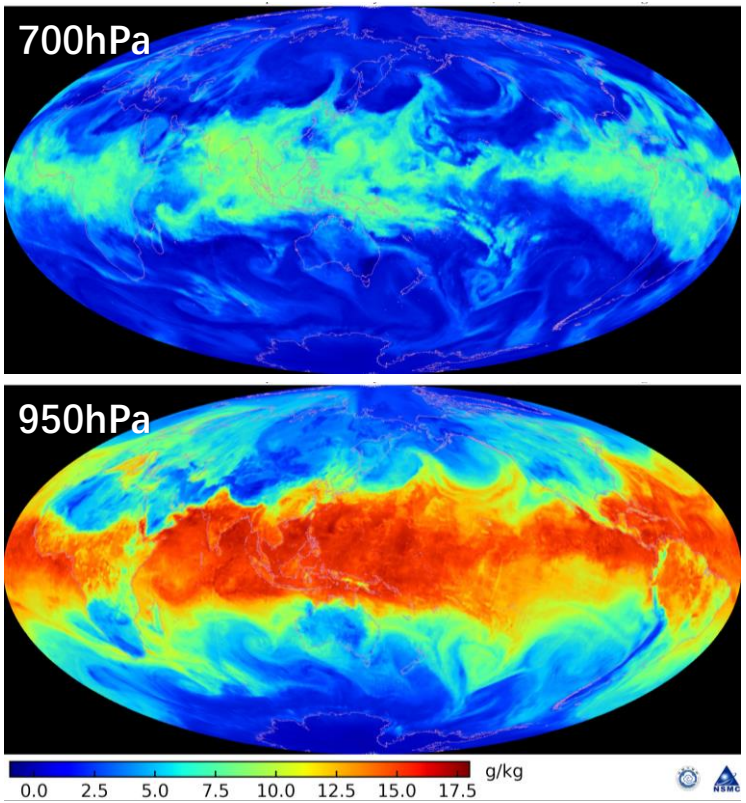




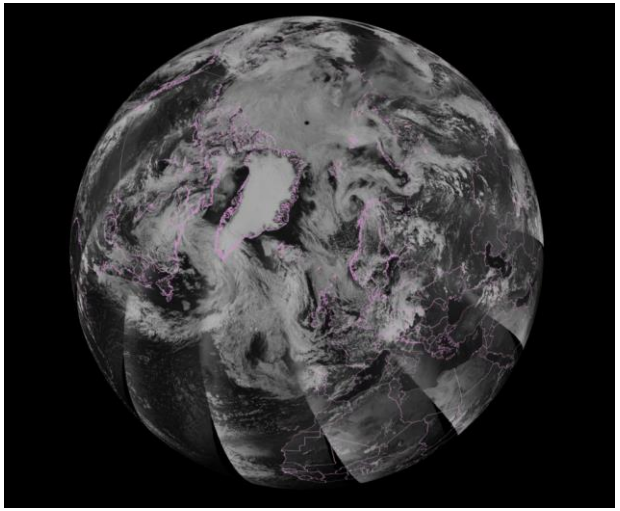
FY-3E global humidity image

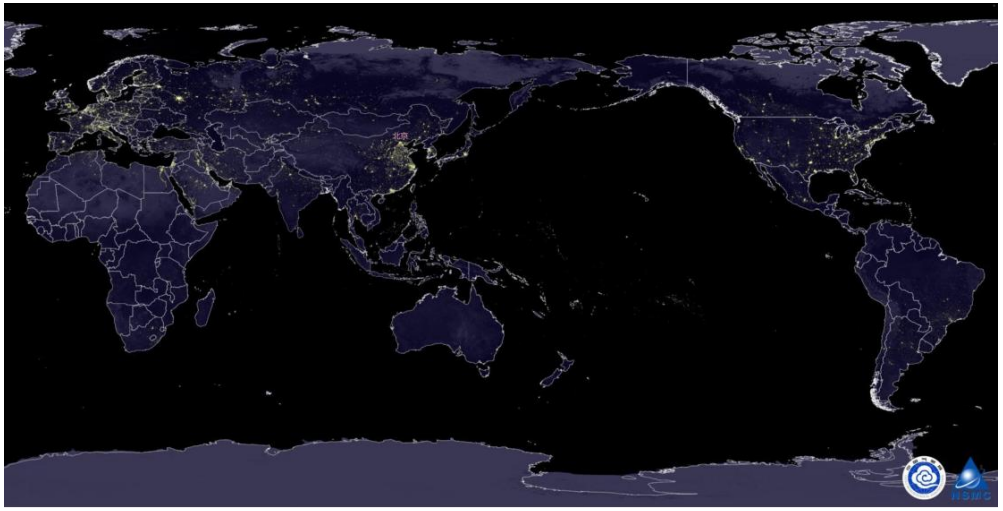
2021.9.27

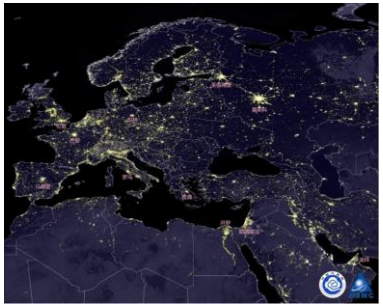


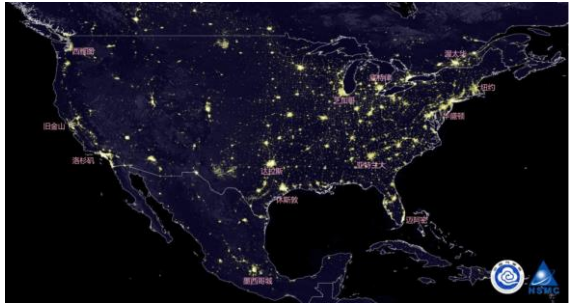


FY-3E City Light Monitoring



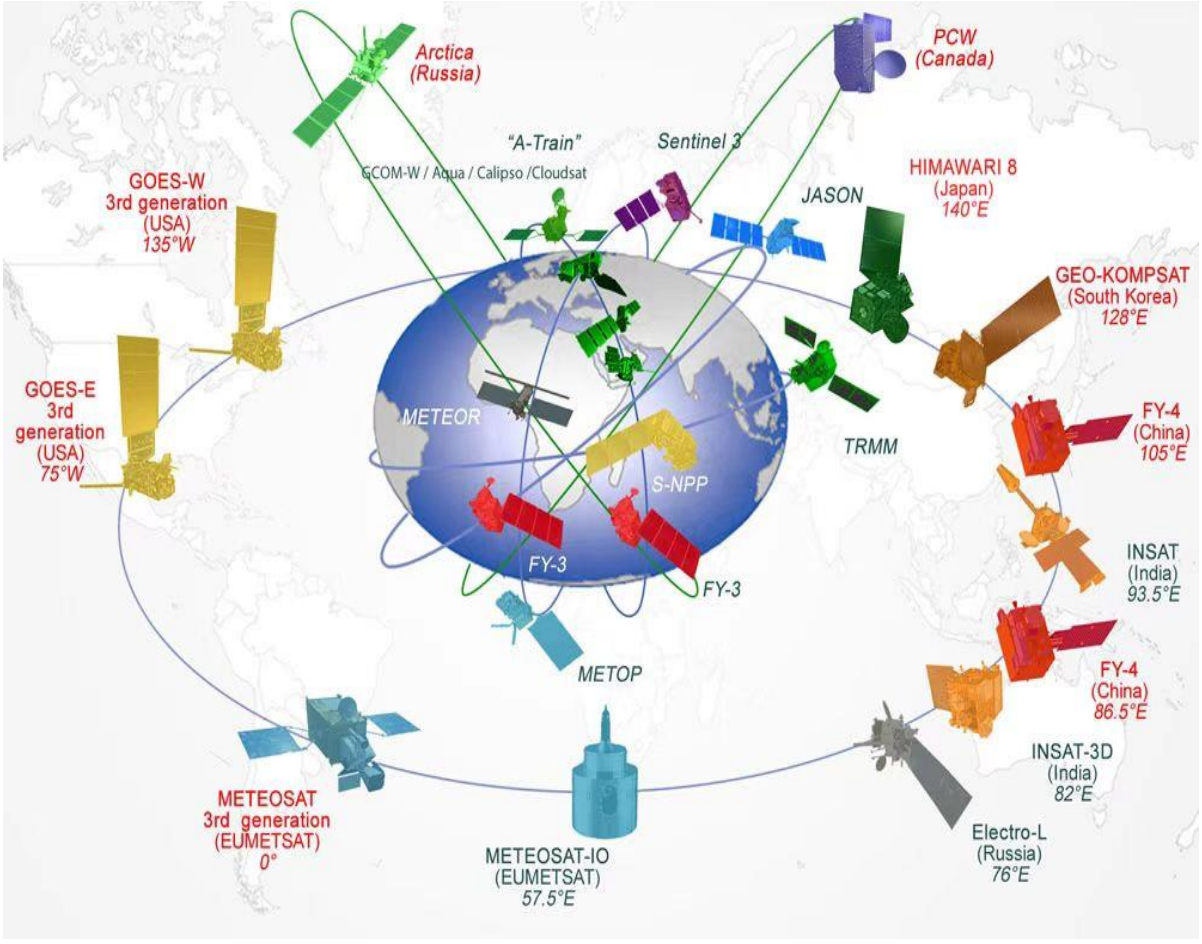




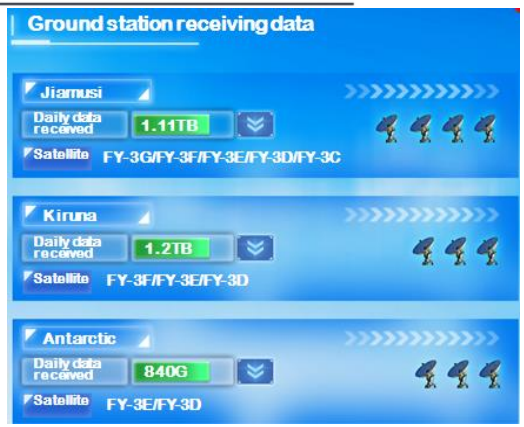


FengYun Constellation

Space-based WMO Integrated Global Observing System



FengYun Constellation– Ground Receiving Station Network



Well-organized Receiving System Ensures Data Services

CONTENTS

FengYun Products

Atmosphere（30+）

- Aerosol
- *Aerosol optical thickness*
- Aerosol over Land Surface
- Total Precipitable Water
- Precipitation
- Rain Type
- Rain Phase
- Radar Rain Rate
- Atmospheric bending angle
- Atmospheric refractive index
- *Atmospheric density*
- Electron density profile
- ***total sulfur dioxide column***
- ***Total Nitrogen Dioxide column***
- Atmospheric humidity profile (GNOS)
- Atmospheric temperature profile(MWTS-III、MWRI、GNOS)
- Atmospheric temperature and humidity Profile(MWHS-II)
- Atmospheric temperature and humidity Profile(HIRAS/MWHS-II/MWTS-III)
- Atmospheric temperature and humidity Profile(MWHS-III/HIRAS)
- Atmospheric temperature and humidity Profile(MWTS-III/HIRAS)
- Atmospheric temperature and humidity Profile(MWHS-II/MWTS-III/MWRI)
- ***Total oxygen column***
- ***Carbon dioxide mixing ratio***
- ***Methane mixing ratio***
- total ozone column
- ***Nadir Ozone vertical profile***
- ***Limb Ozone vertical profile***

Cloud & Radiation（10+）

- Equivalent emission radiation for clear sky
- *OLR of HIRAS*
- *Cloud Top Parameters*
- Top-up Radiation and Clouds
- Surface radiation budget
- ***Total solar irradiance downward from the atmospheric top***
- ***solar band irradiance at the top of the atmosphere***
- Cloud Mask
- Cloud Amount
- CLoud Classification
- *Cloud Top Temperature/Cloud Top Pressure*
- *Cloud Optical Depth*
- *the Effective Radius of Cloud*
- Outgoing Longwave Radiation
- ***Polar Winds***
- ***Water leaving Reflectance***
- ***Cloud Liquid Water Content***

Space Weather（10+）

- ***zeta potential***
- ***Radiation dose***
- ***Magnetic field***
- ***particle(Medium and high energy proton、Electronic three-directional flow、Particle throw angle)***
- ***scan imaging***
- ***Push-broom scan imaging***
- ***Aurora egg morphology***
- ***Particle sedimentation***
- ***IPM night product***
- ***IPM daytime product***
- ***IPM multi-angle product***
- ***Solar extreme ultraviolet imager***
- ***solar x ray imager***

Ocean

- Aerosol over Ocean
- Total ***Precipitable Water over Ocean***
- MERSI Sea Surface Temperature
- ***MWRI Sea Surface Temperature***
- ***MWRI Sea surface wind direction***
- GNOS Sea surface wind Speed
- PR Sea surface wind Speed
- PR Sea surface wind direction

Ice&Snow

- Sea ice
- Snow Cover
- Snow Depth
- SWE
- Polar Sea Ice Cover

Biology

- ***Leaf area index***
- Fraction of Photosynthetically Active Radiation
- Net Primary Production
- ***Chlorophyll fluorescence***
- Vegetation Index

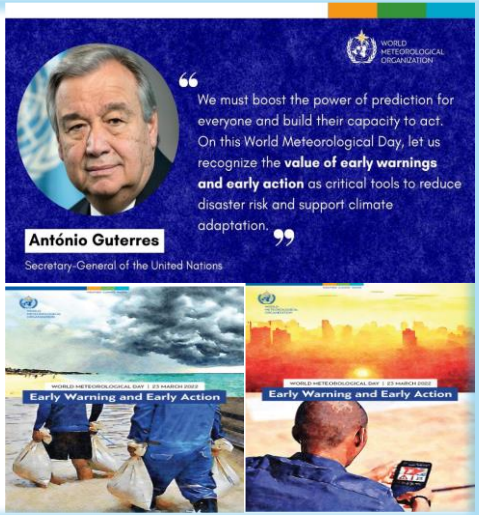
Land（10+）

- Land Reflectance Factor
- Land Surface Temperature
- *Land Surface Bidirectional Reflection/ Albedo*
- *Land Cover*
- Dust Product
- *Near-Constant Contrast Image*
- ***City Light/Urban low-light background mosaic***
- *Land Surface Temperature*
- *Soil moisture content*
- Surface pressure
- surface reflectance

FengYun Satellite Support Sustainable Development Goals (SDGs)

FengYun Satellites Support Early Warning Actions

The United Nations will spear-head new action to ensure every person on Earth is protected by early warning systems within five years.



UN: Global Early Warning Initiative

WMO: Early Warnings for All

Fengyun Applications

FengYun Applications

- **Weather Monitoring**
  - Tropical Cyclone
  - Heavy Rain
  - Dust Storm
  - Fog
- **Climate Monitoring**
  - Drought
  - Carbon neutral
  - Ice and Snow
- **Natural Disaster**
  - Flood
  - Fire
  - Volcanic Eruption
  - Earthquake
- **Environment Monitoring**
  - Vegetation Growth
  - Water Body Change
  - Atmospheric Composition
  - Heat Island

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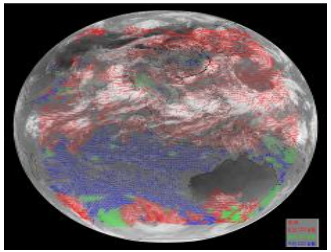
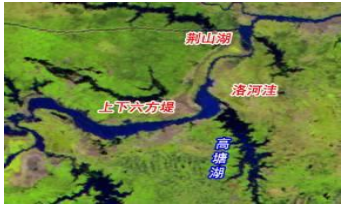
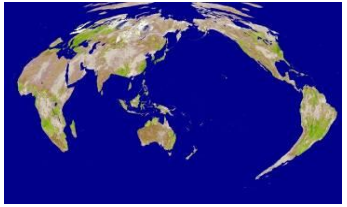
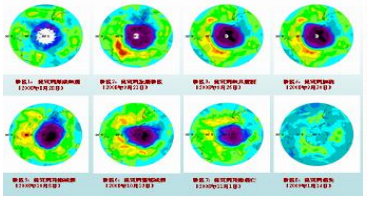


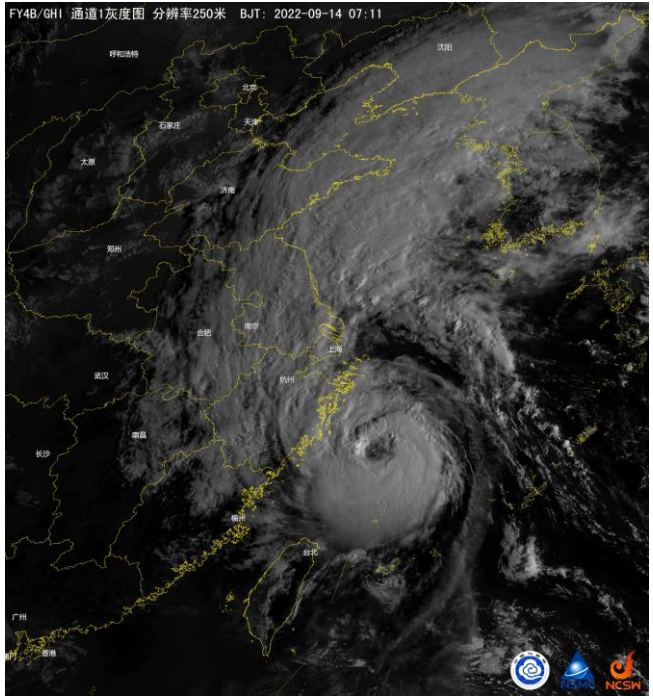




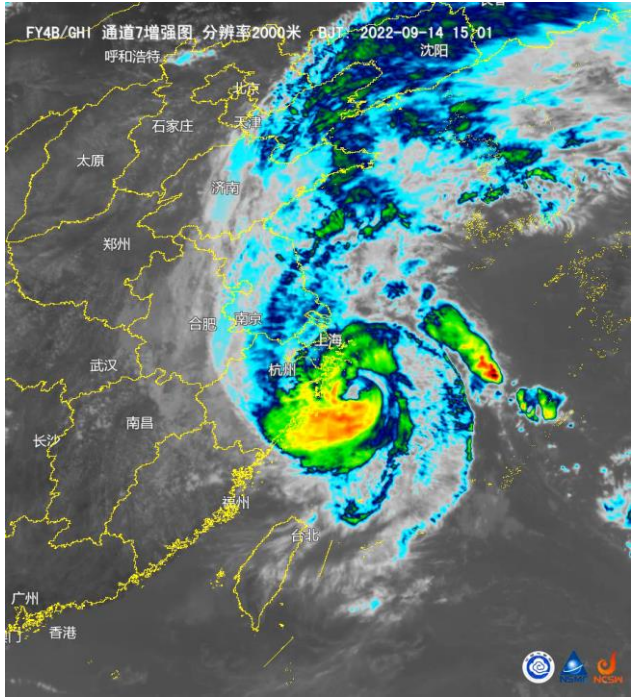




Applications：Weather Monitoring

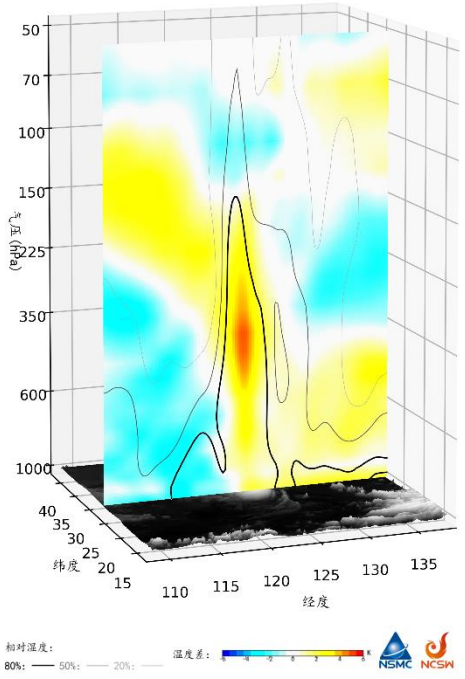
Severe Typhoon MUIFA



FY-4B cloud image



FY-4B Infrared enhanced image

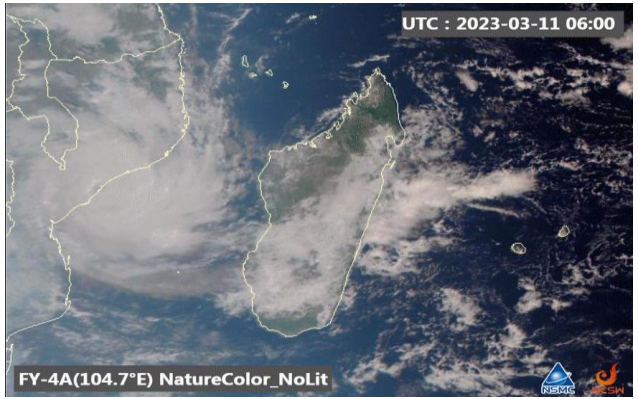


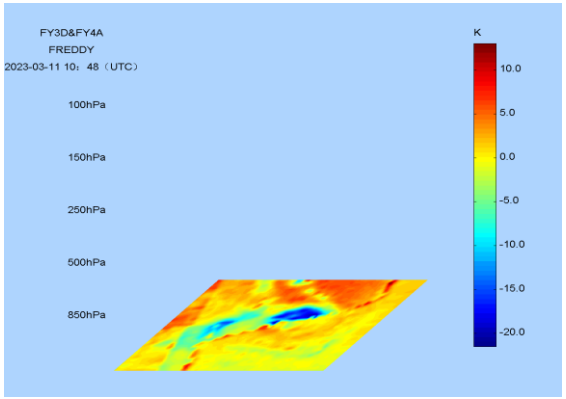
Structure Diagram of Typhoon Warm Center

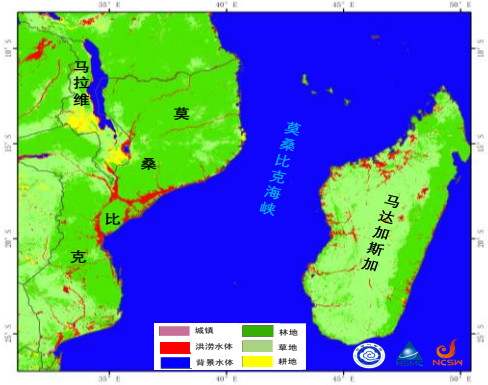
Applications：Weather Monitoring

The Tropical Cyclone FREDDY

- The cyclone FREDDY is set to break records for the longest-lasting storm, it has already caused immense damage in Mozambique and Madagascar;
- FengYun meteorological satellite have monitored the entire movement and development of FREDDY



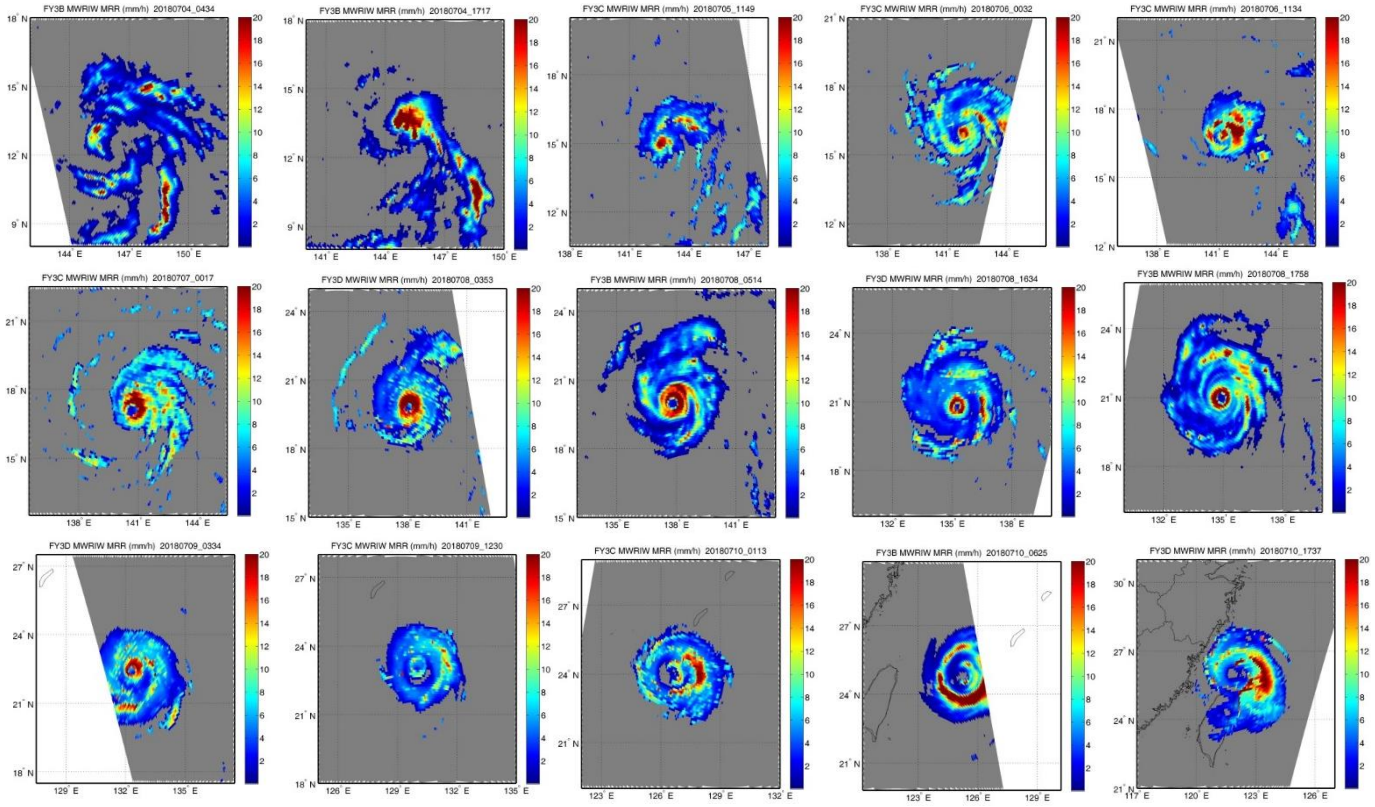




Applications：Weather Monitoring

FY-3B/C/D continuously track and monitor the typhoon “Maria” precipitation.

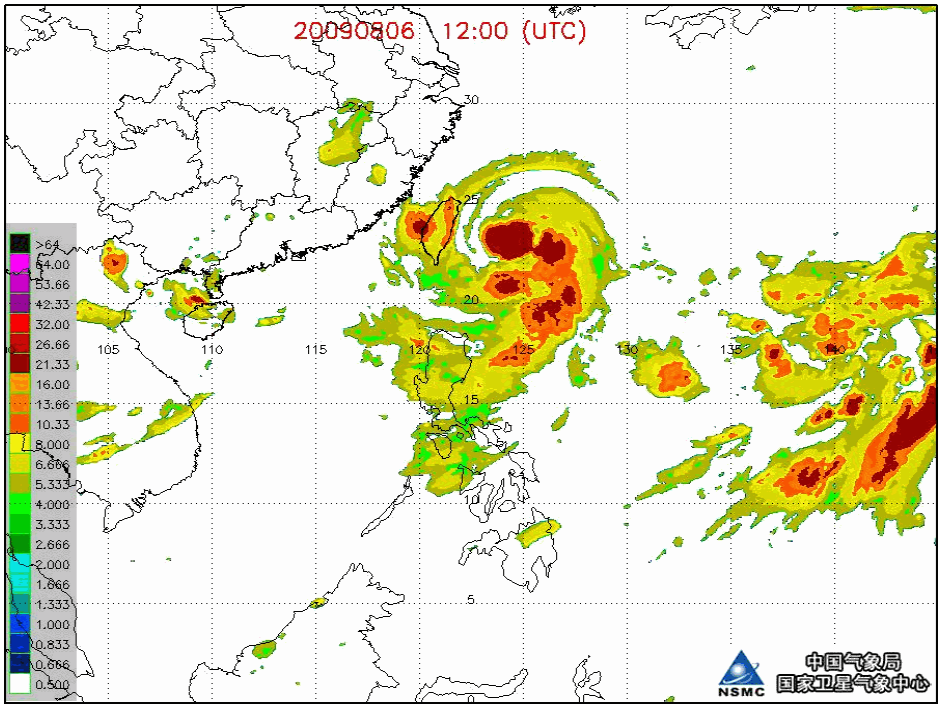
The strong precipitation belt gradually transitions from the wind eye wall to the peripheral spiral cloud belt

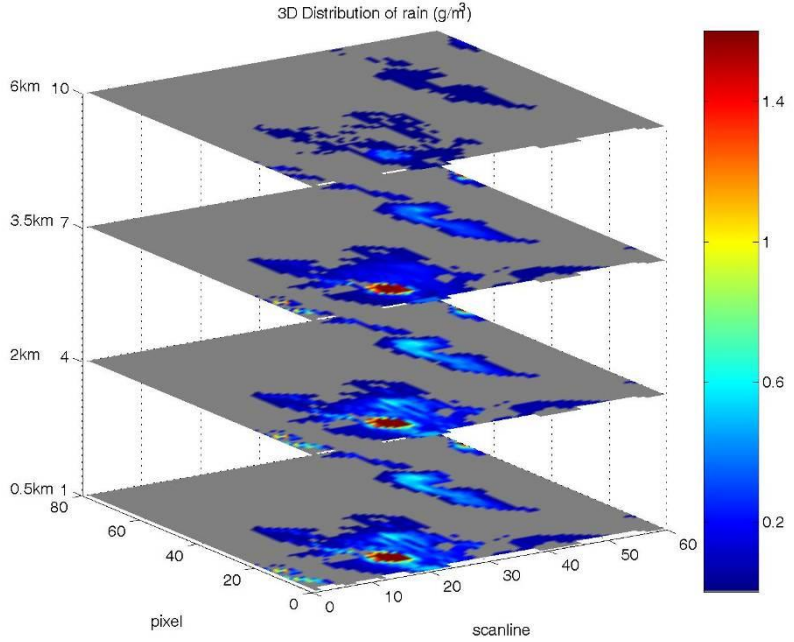


Applications：Weather Monitoring

3D precipitation analysis

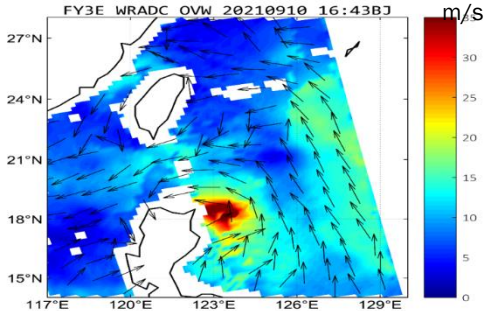
- Strong rainfall structure within Typhoon related highly with low frequency map (10 and 18 GHz)

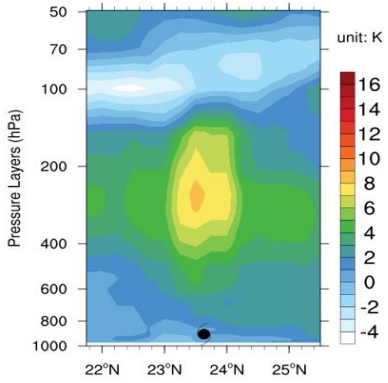




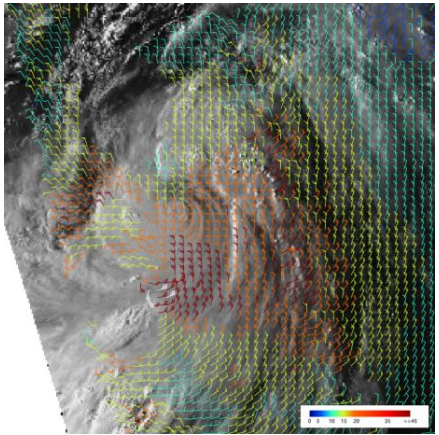
Applications：Weather Monitoring

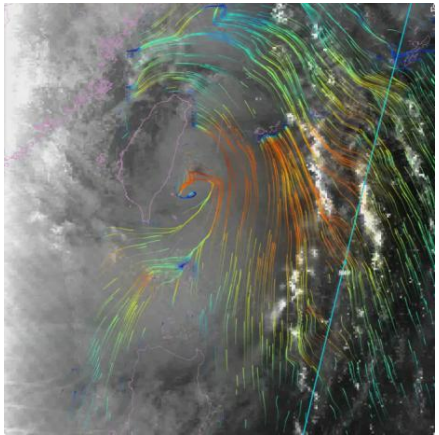
FY-3E products

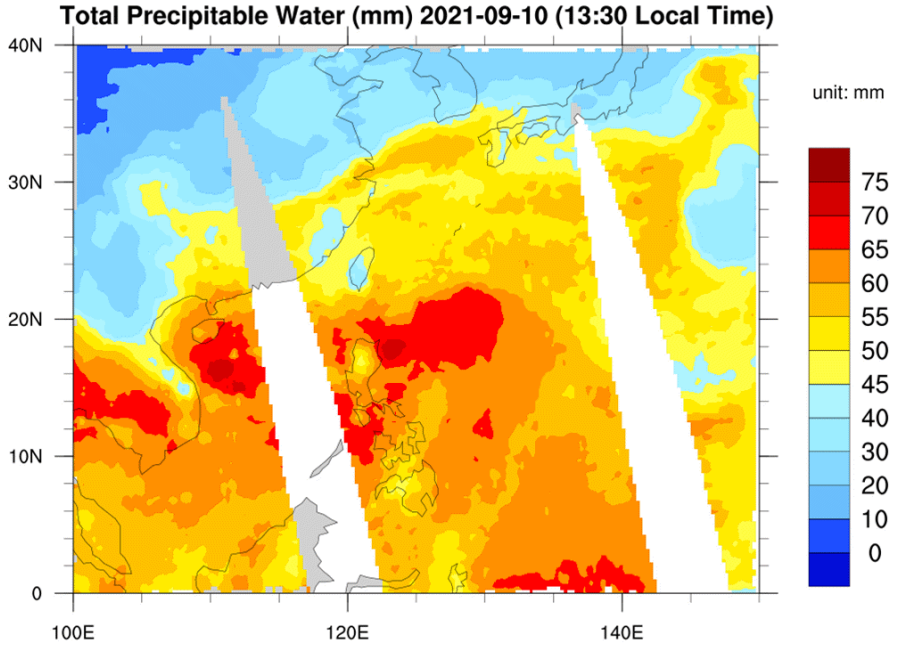




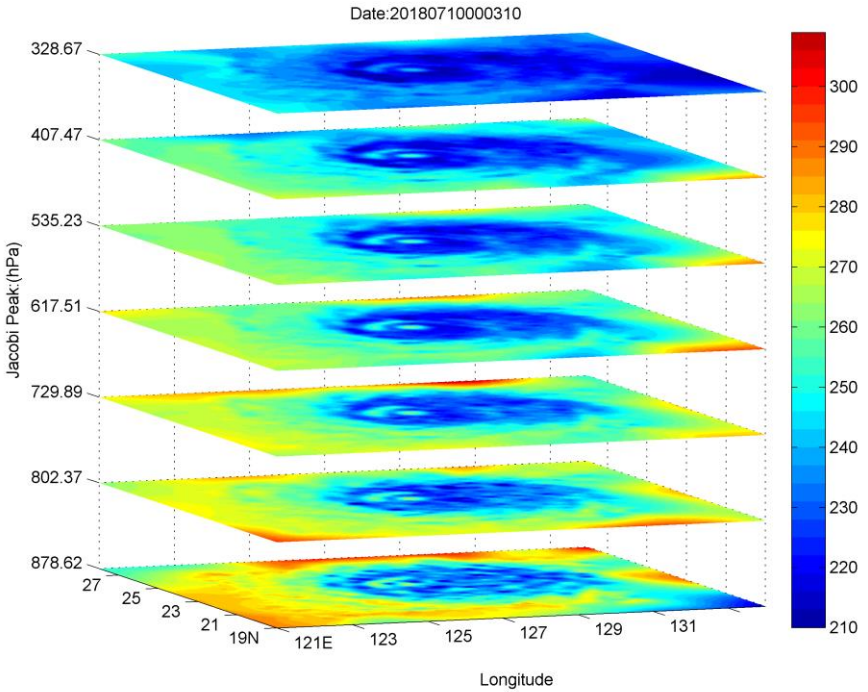
FY-3E Low-light cloud at night



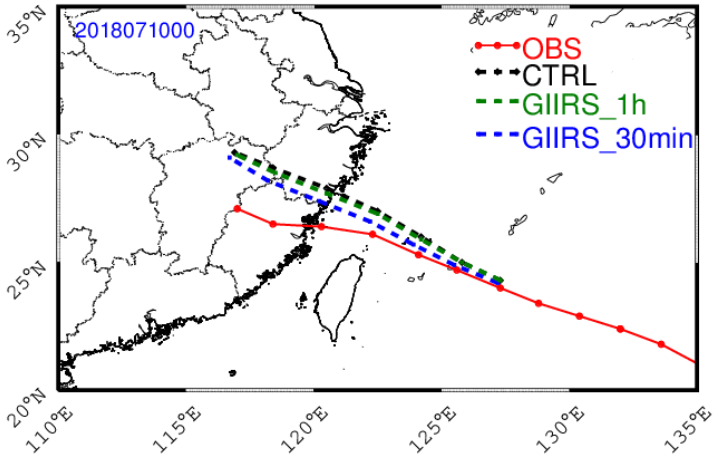




Applications：Weather Monitoring



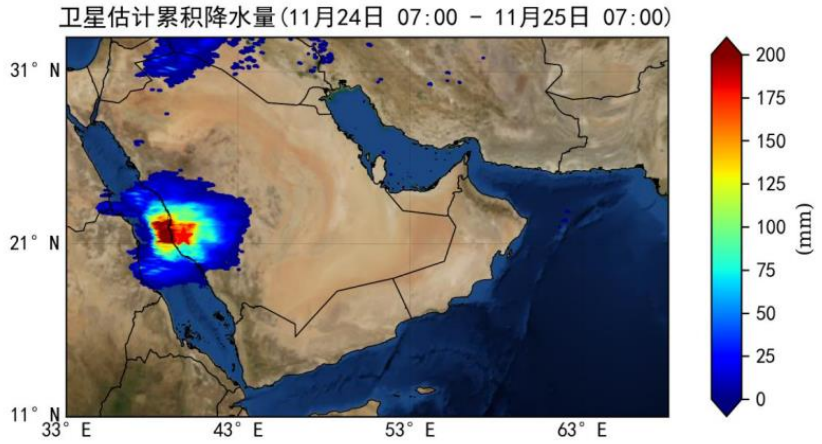
Impact of GIIRS high temporal observations on Typhoon Maria forecasts (72-h)

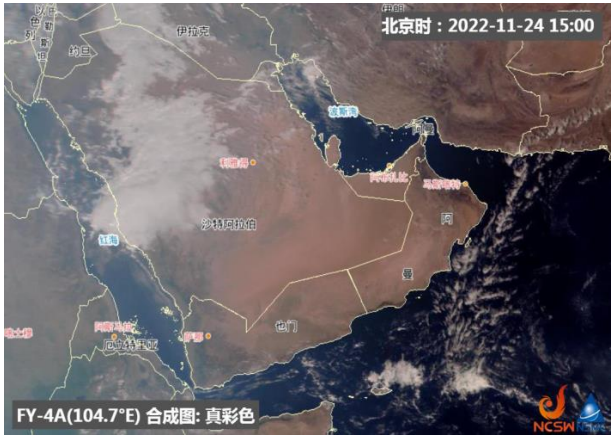


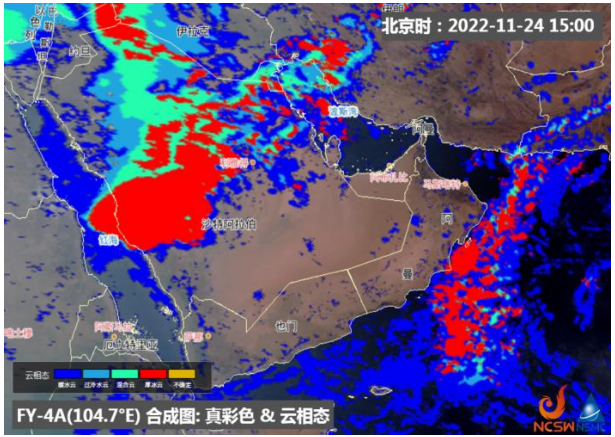
Applications：Weather Monitoring

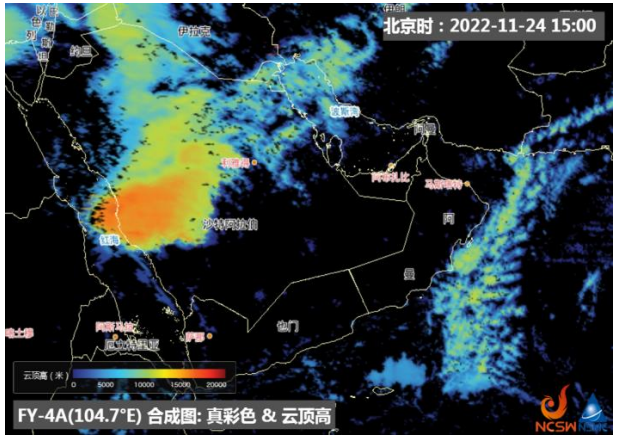
The Heavy Rain Monitoring over Saudi Arabia

- Severe flash flooding struck in western parts of Saudi Arabia after torrential rain on 24 November 2022, the city of Jeddah in Mecca Province recorded 179 mm of rain in 6 hours;



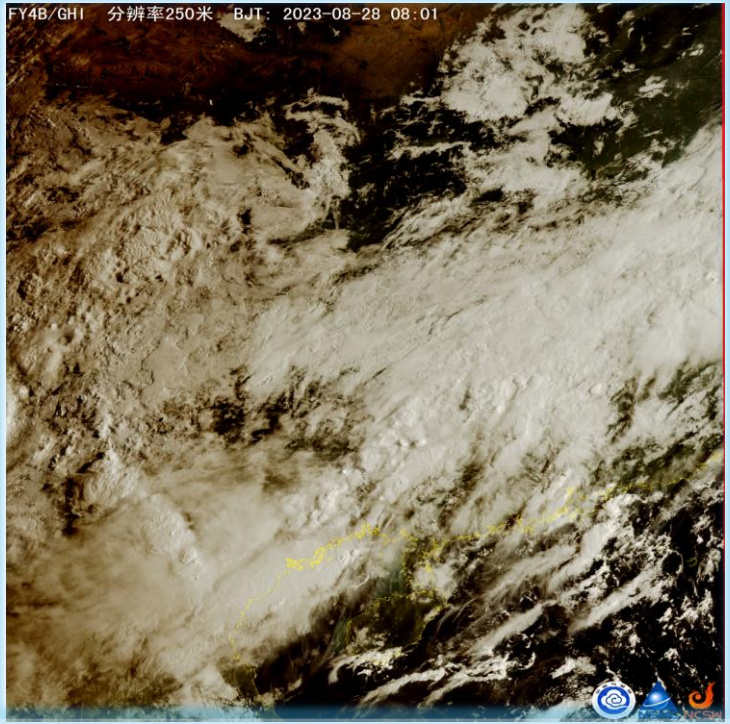


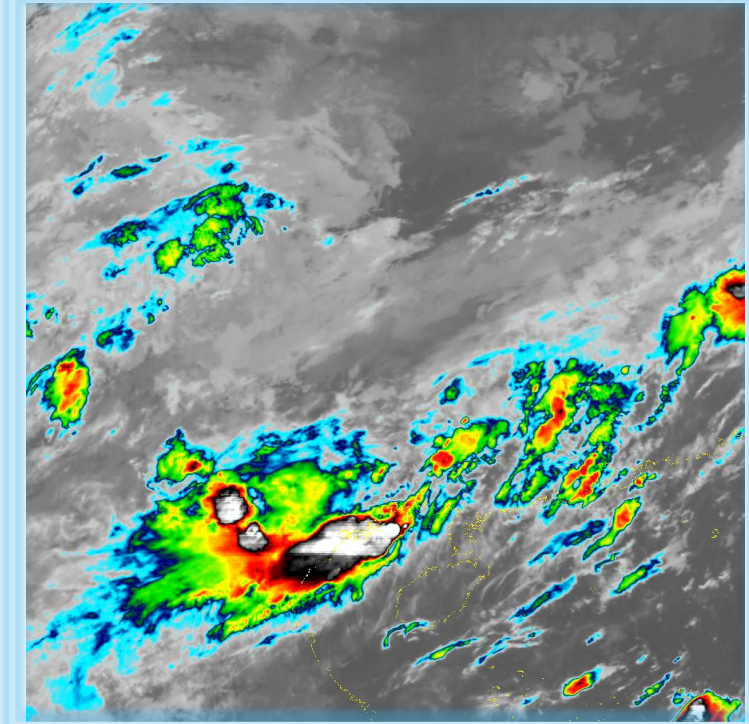




Applications：Weather Monitoring

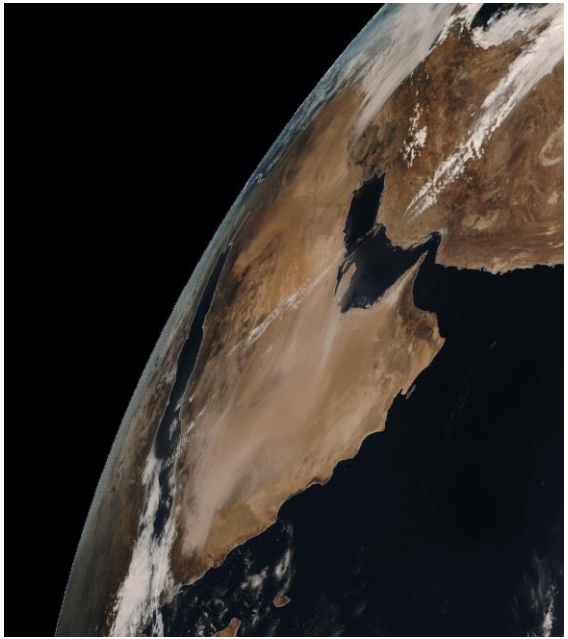
Severe Convection

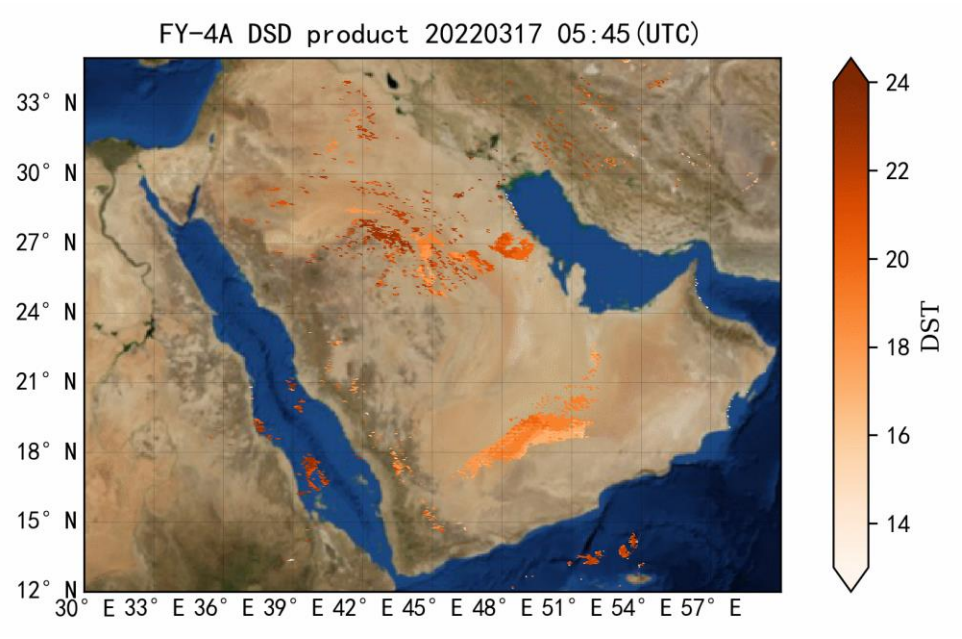




Applications：Weather Monitoring

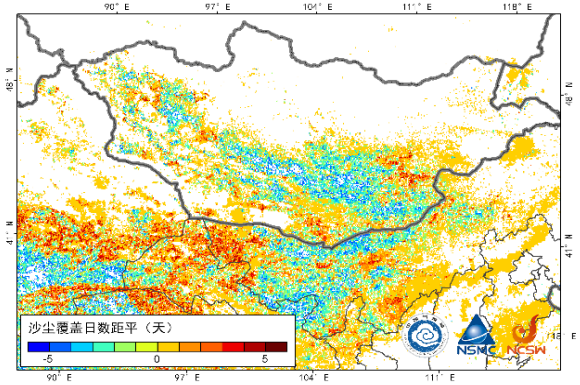
The Dust Storm Monitoring in Saudi

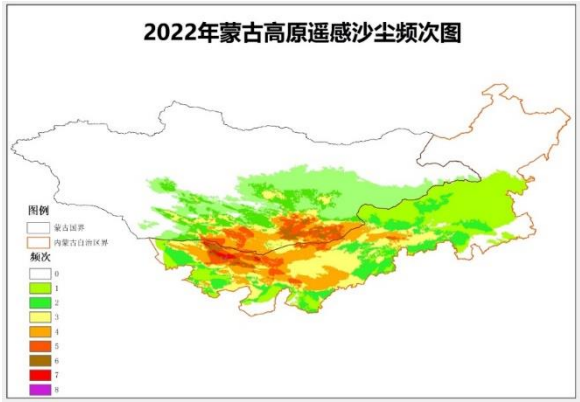




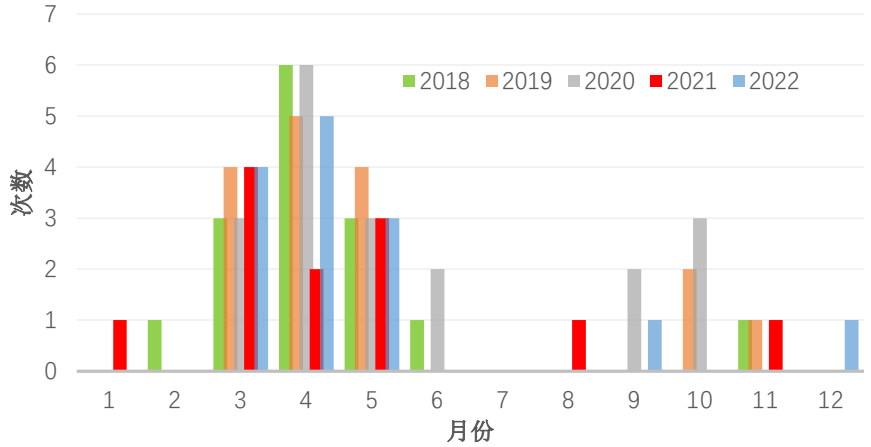
Applications：Weather Monitoring

Dust storm monitoring over Mongolian Plateau





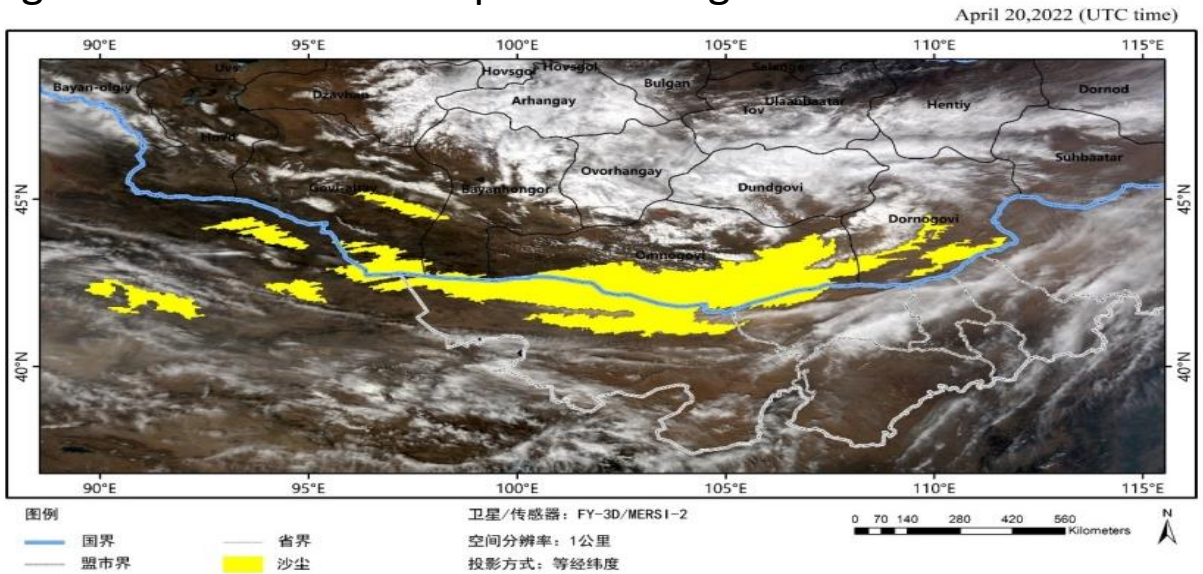
- Fengyun Meteorological Satellite monitored 8 large-scale dust storms on the Mongolian Plateau in 2023, significantly higher than the same period in previous years;
- This relates to land surface and weather conditions.



Applications：Weather Monitoring

The Dust Storm Monitoring over Mongolian Plateau

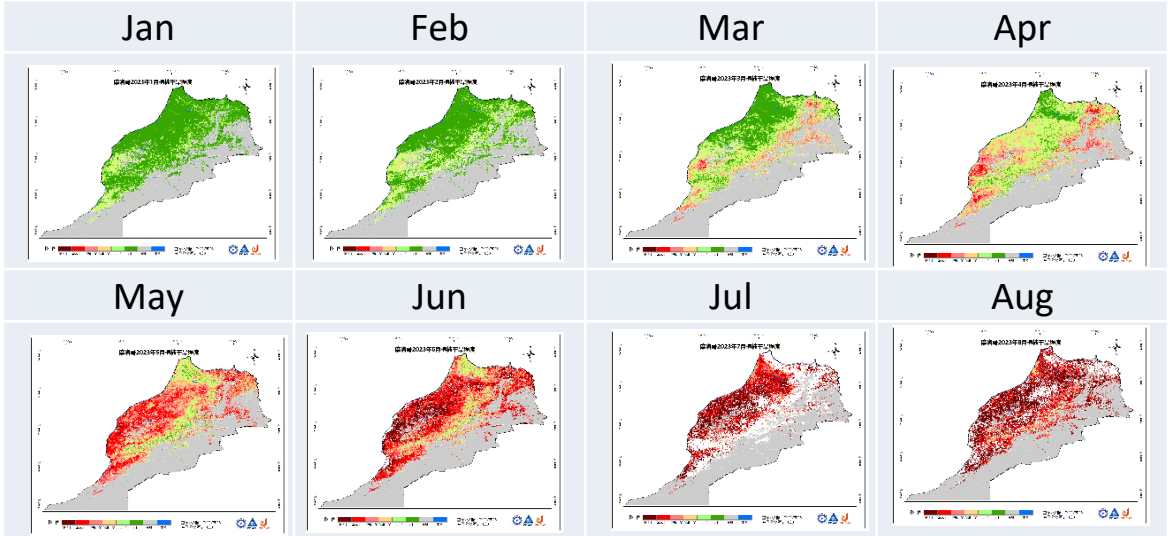
- The results of remote sensing by FY-3D satellite received in the afternoon of April 20, 2022 showed that there was a widespread dust weather process in the western of Inner Mongolia and the southern part of Mongolia.



Applications：Climate Monitoring

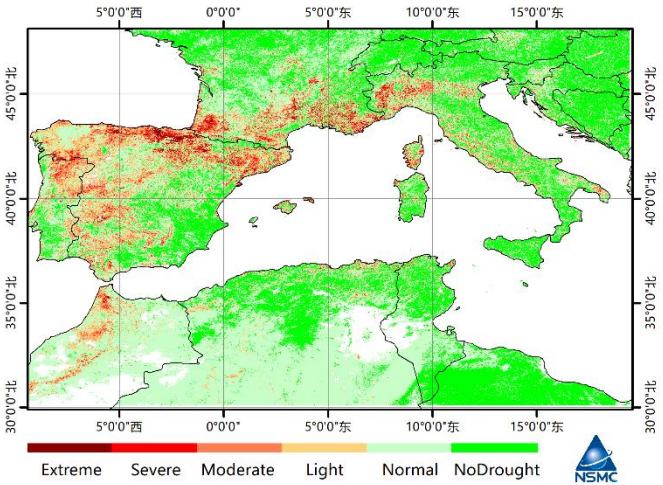
Using FY-3D/MERSI data to generate a drought index monitoring map from January August in 2023, it can be seen that the vegetation health level was the best in January. After March, vegetation growth began to deteriorate and drought began to spread from southern Morocco to the entire region.

Drought Monitoring in Morocco

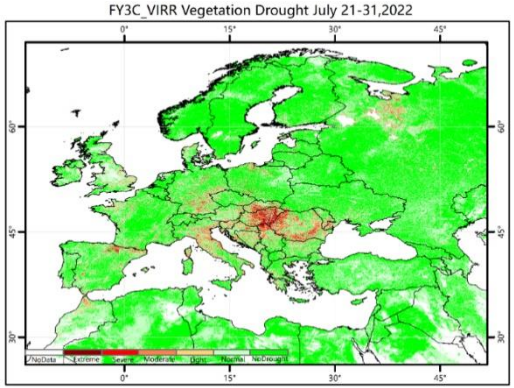


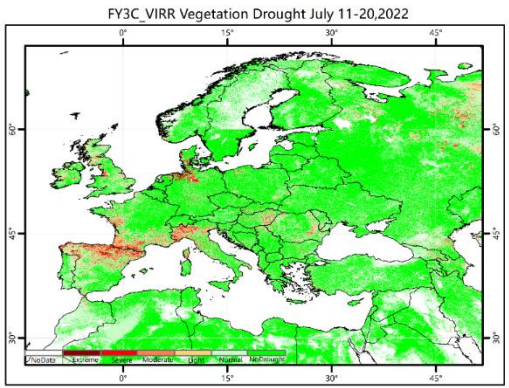
Global Agricultural Drought Map

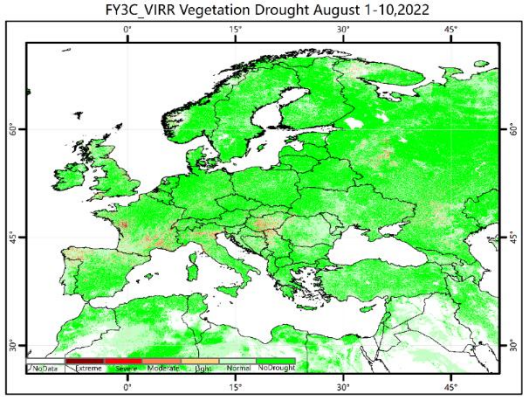
Drought conditions in Europe



Drought Map for West Europe in **middle of June 2022**







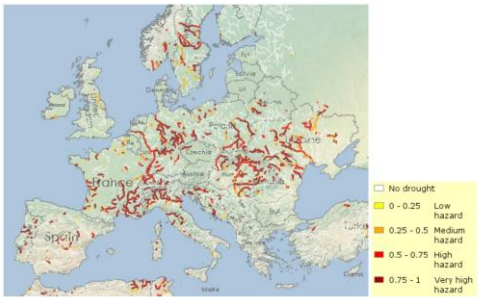


Figure 7: *Low-Flow Index (LFI) at the end of June 2022. A Low-Flow Index of 0 corresponds to no drought and a value of 1 to the highest drought hazard.*

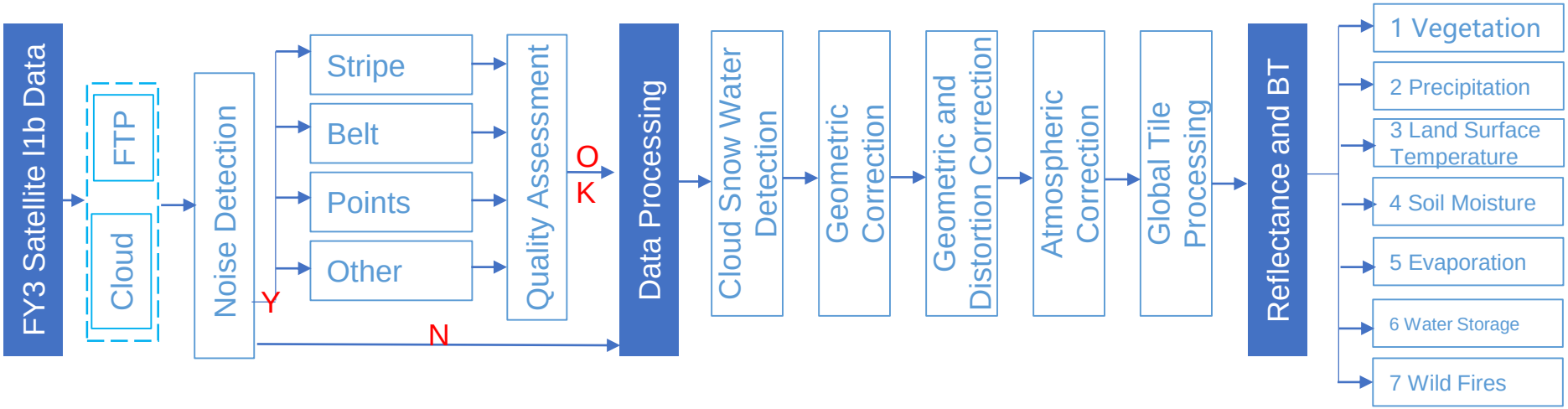
Rhine

Danube

@ Drought in Europe July 2022

Drought Factors Monitoring

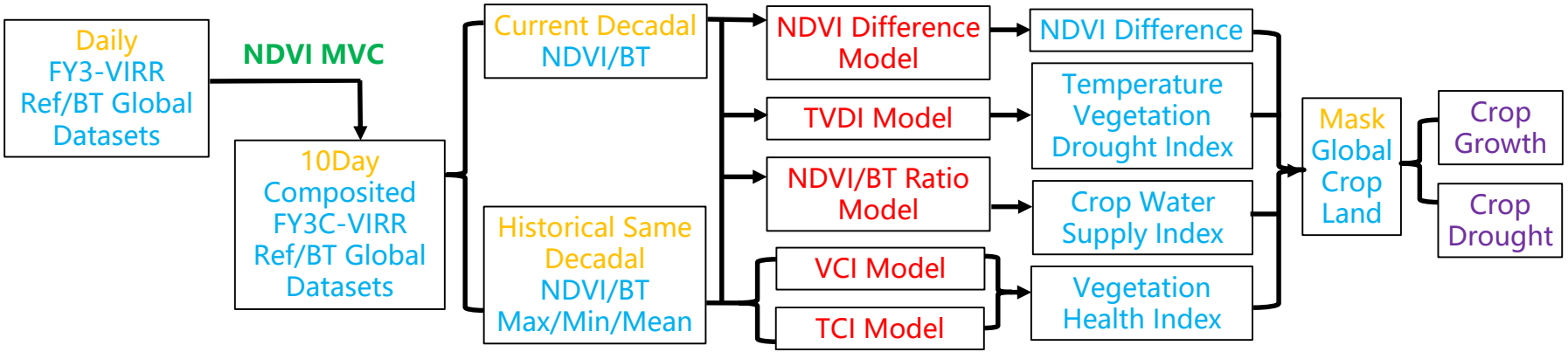
FY Satellite Data Processing for Drought Monitoring



Data Download → Noise Removal → Cal/Geometric/Atmospheric Correction/Global Tiling → High Level Products

Flowchart to retrieve the parameters for further applications

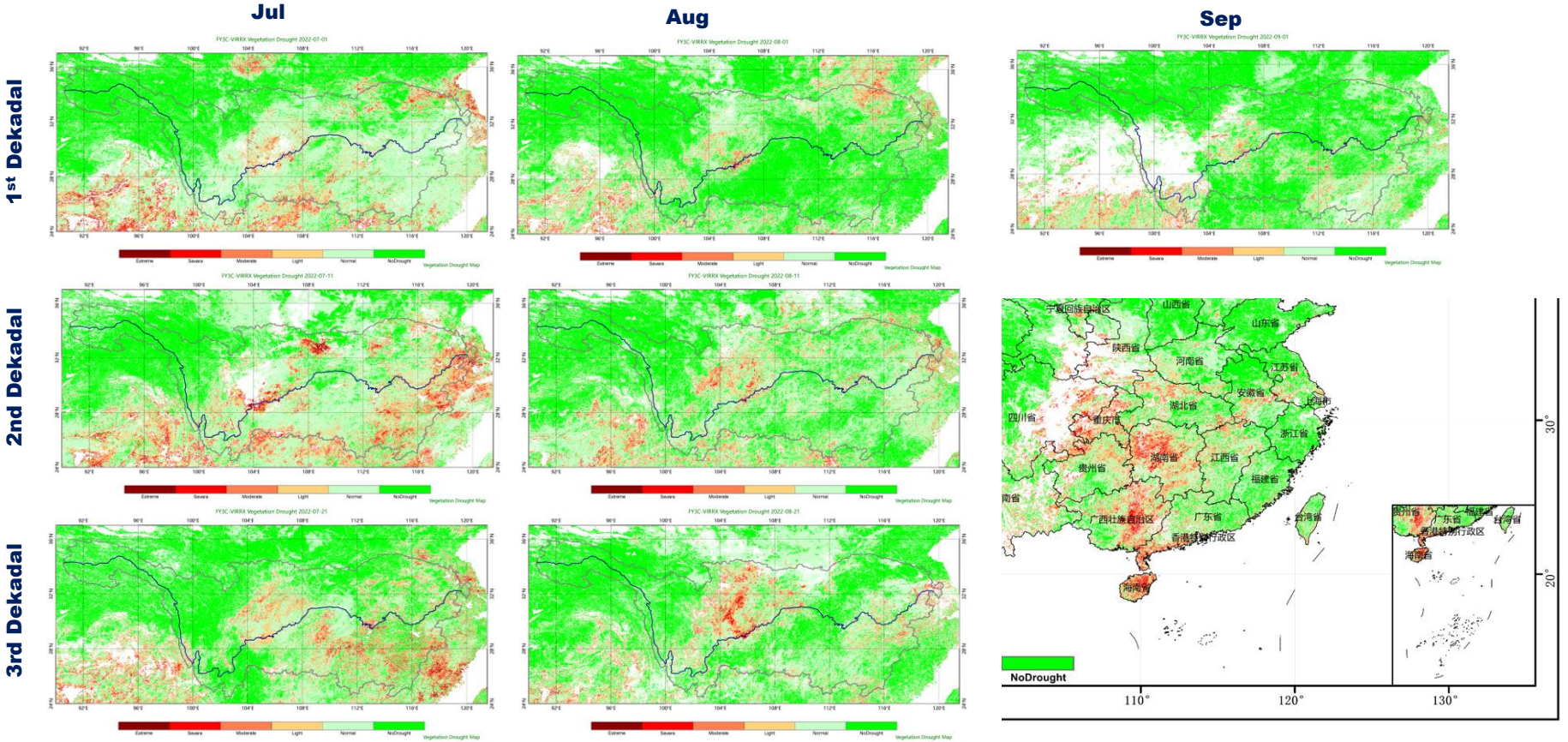
Drought Evaluation



Flowchart to develop the drought Evaluation indices

Drought Evaluation

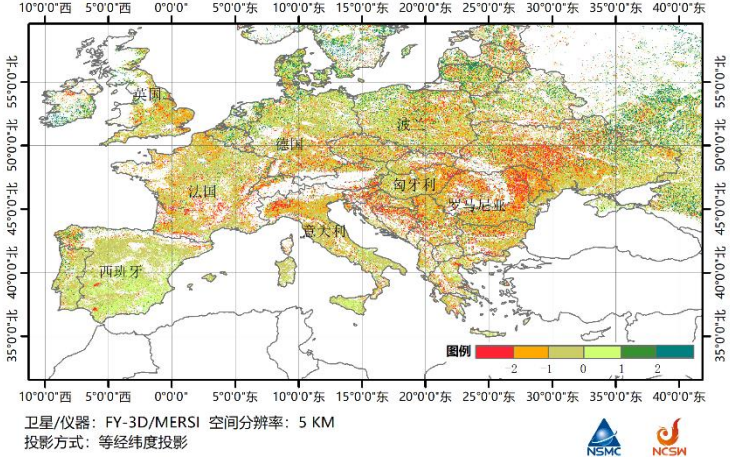
Drought conditions in China



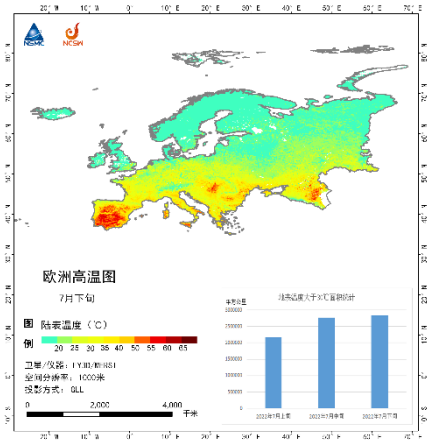
Applications：Environment Monitoring

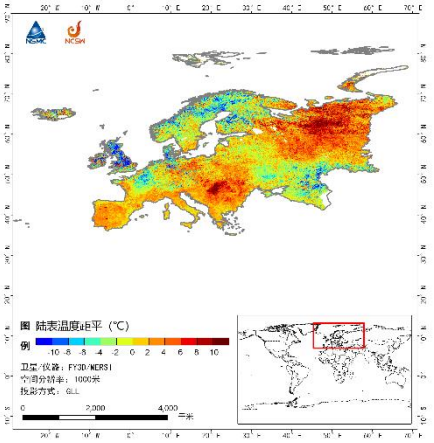
Crop Growth in Europe

Since July 2022, the area of surface high temperature in Europe has continued to increase, and the high temperature and drought are affecting the growth of crops in Europe.



FY-3D leaf area index Image





FY-3D Surface Temperature Monitoring Map

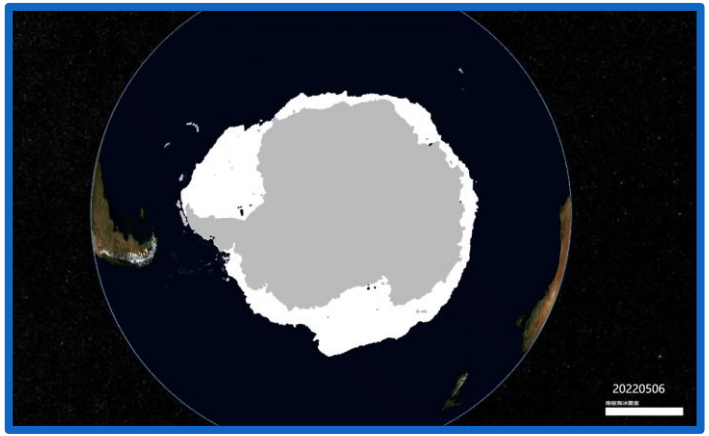
Applications：Climate Monitoring

Sea Ice Monitoring

- FengYun satellite the observation results shows sea ice extent in Antarctica reached an minimum in February, 2023.
- The Arctic is warming more than twice as fast as the global average warming.

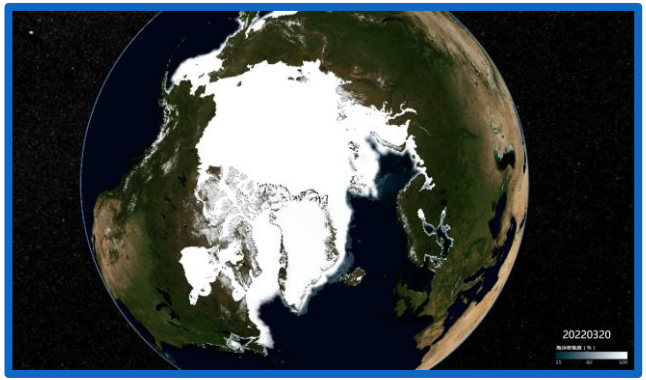
FY-3E/WindRAD Antarctic Ice

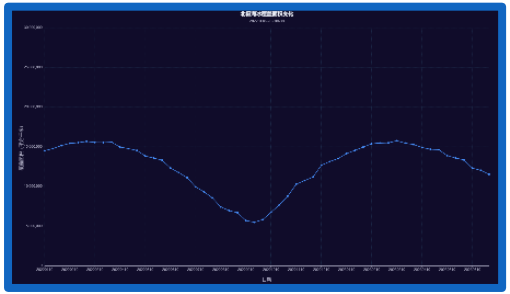
(20220506-20230601)

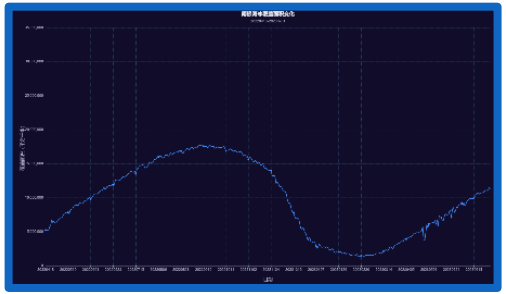


FY-3D/MWRI Arctic Ice

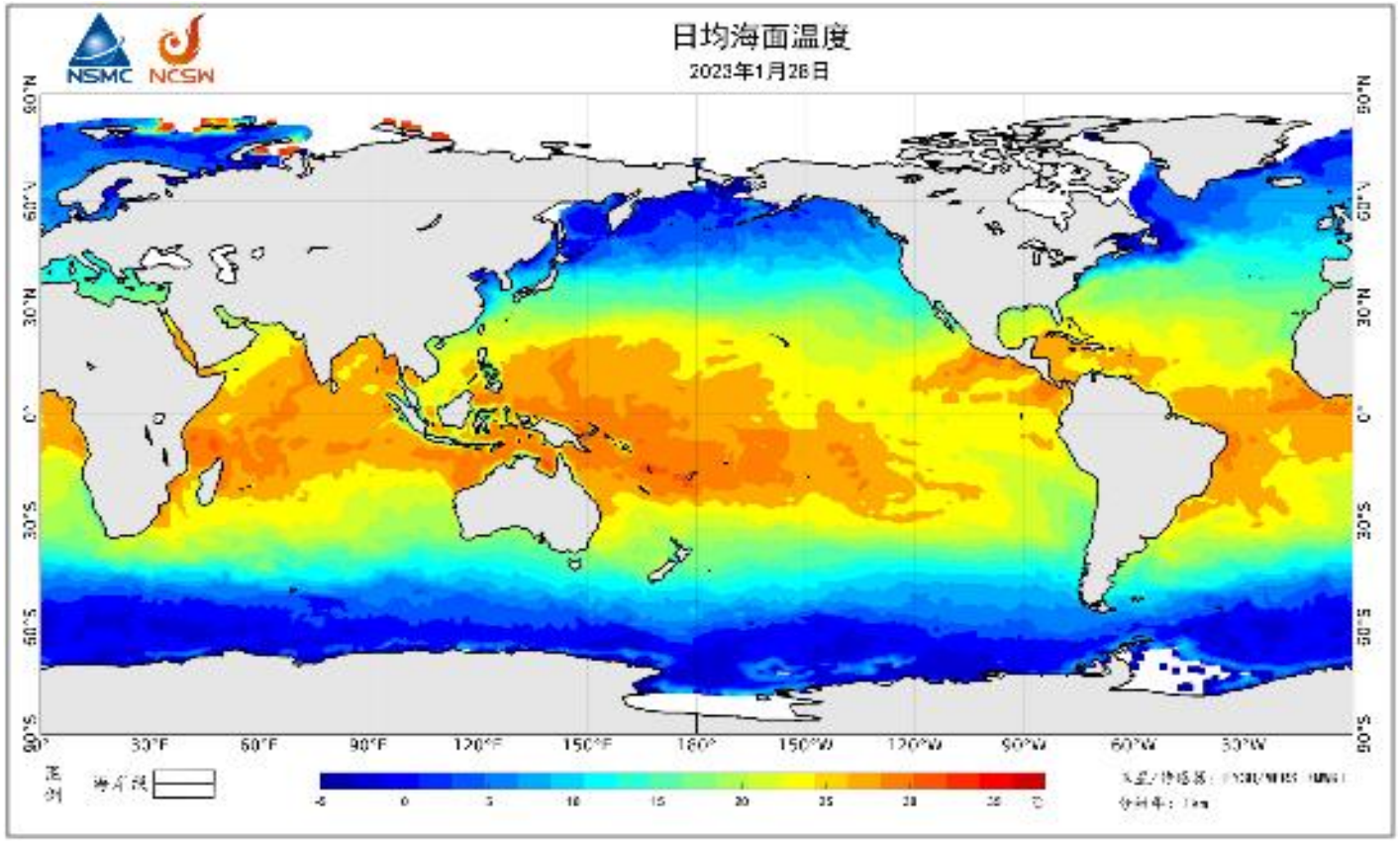
(202201-202306)



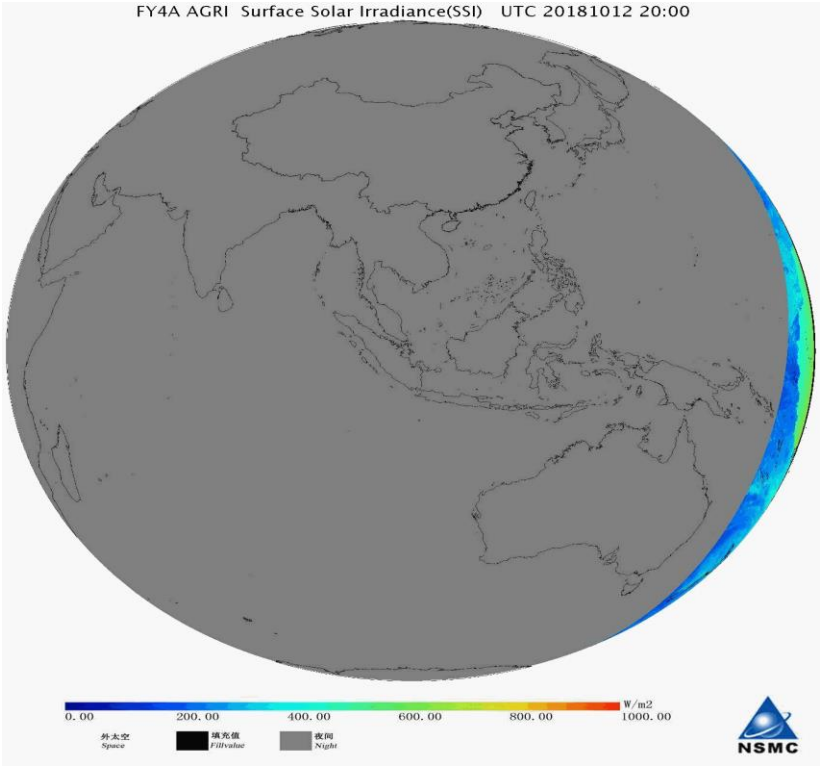




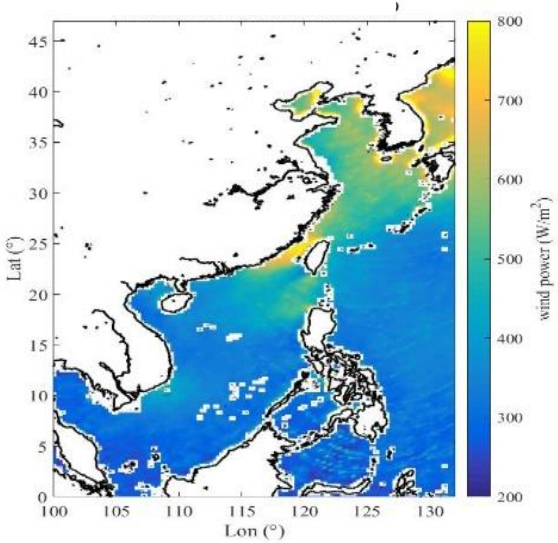
ENSO Analysis



Solar Enegry

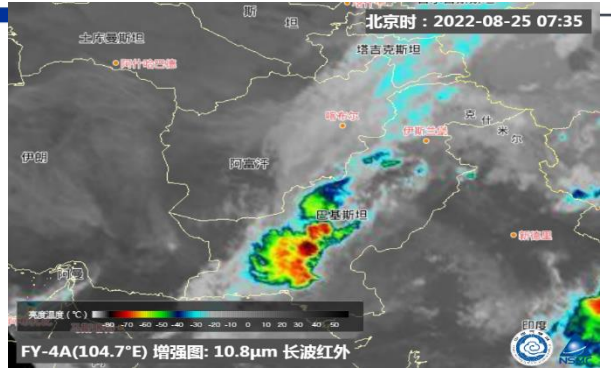


Wind Power

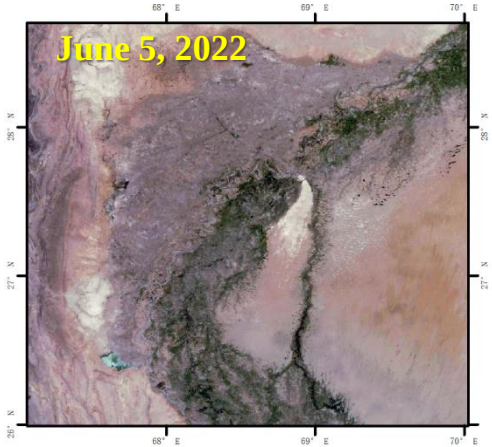


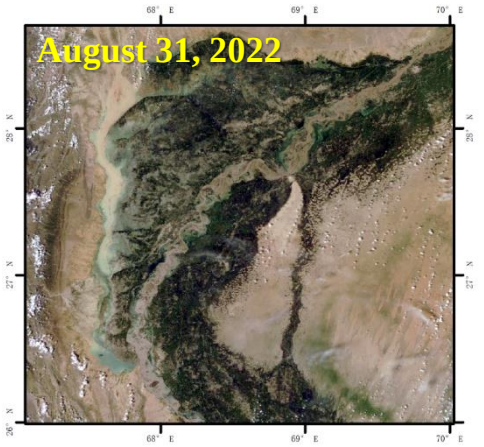
Applications：Natural Disaster

Pakistan has suffered heavy rainfall from the middle of June to September this year, Continuous rainstorm leads to flood disaster.



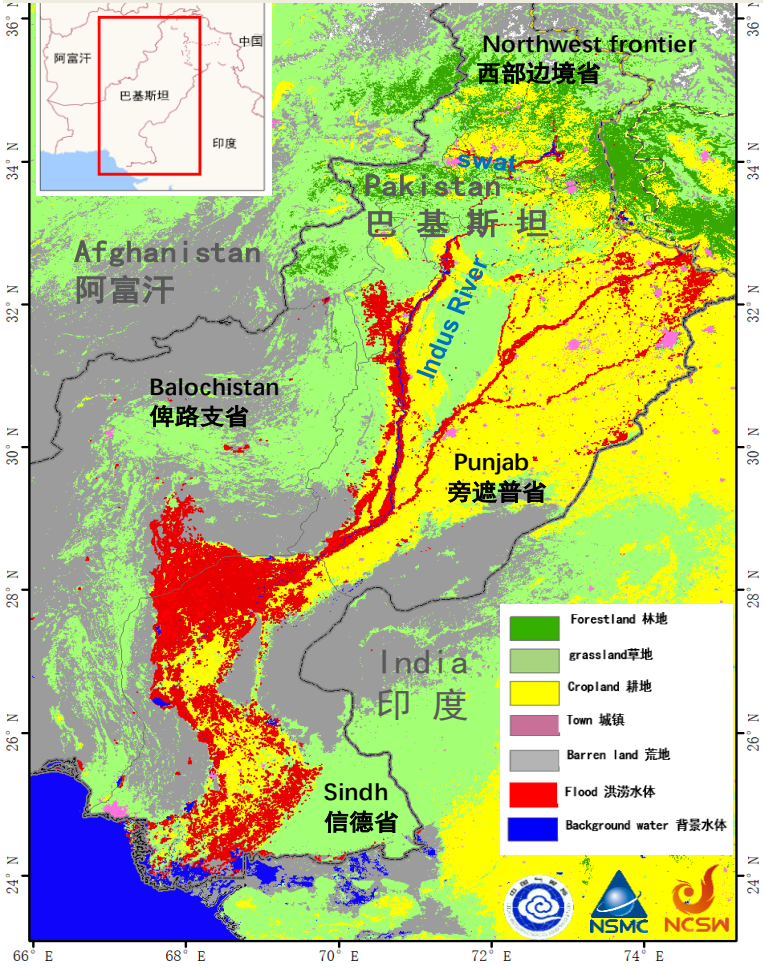
FY-4A Infrared Enhanced Image
2022-08-25 07:00



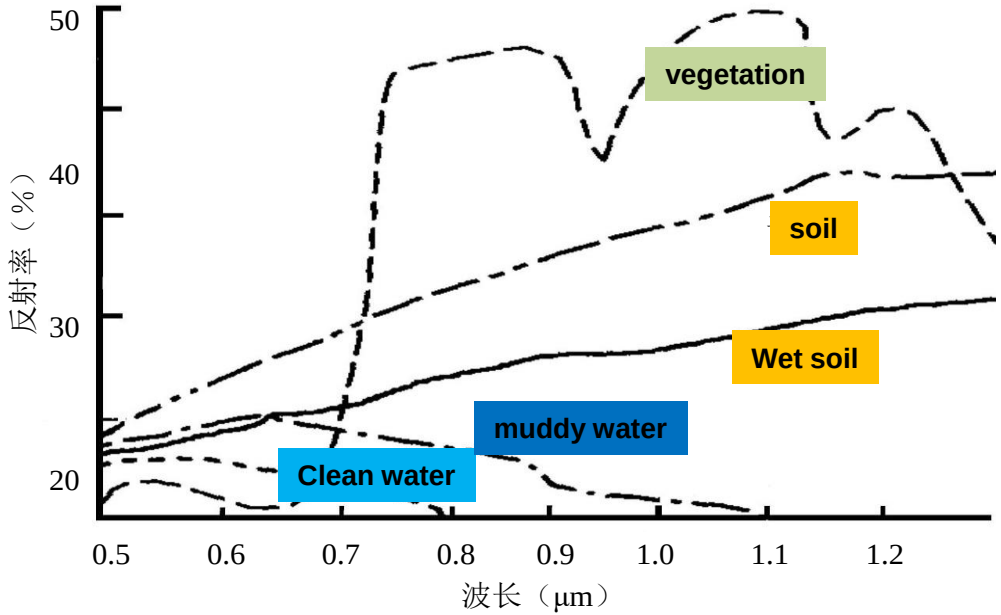


2022-06-05 vs 2022-08-31

Flood in Pakistan



Theory of flood monitoring by using optical satellite remote sensing data



Spectral characters of typical earth surface subjects

Water body identification is the base of flood monitoring. Water body has a strong absorption in near infrared channel, leading to a very low reflectance in this channel and a lower reflectance than in visible channel. On the contrary, vegetation and soil has a low reflectance in visible channel but a much higher reflectance in near infrared channel.

Surface water detection algorithm

1）**Difference model:**

DI=NIR-RED, and
NIR<A1, RED<A2, DVI<A3
A1、A2、A3 :threshod value

2） **Ratio model:**

RI=NIR/RED*k， and
NIR<A1, RED<A2, RVI<N
N:threshod value，k:coefficient of amplification

3）**NDVI model**

NDVI= (NIR-RED) / (NIR+RED) *k ， and
NIR<A1, RED<A2, NDVI<N
N:threshod value，k:coefficient of amplification

4) NDWI model

NDWI=(Green-NIR)/(Green+NIR)
Disadvantage： soil and building

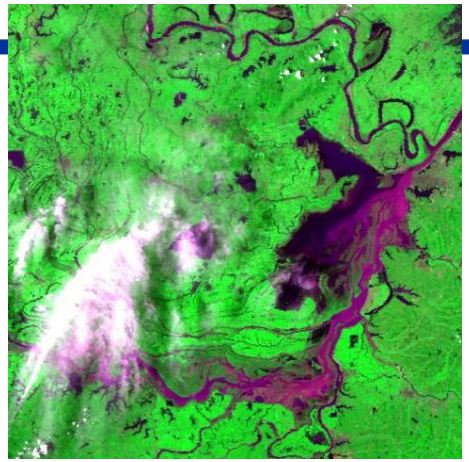
5) Modified NDWI model

MNDWI=(Green-MIR)/(Green+MIR)
Disadvantage： shadow and residential areas

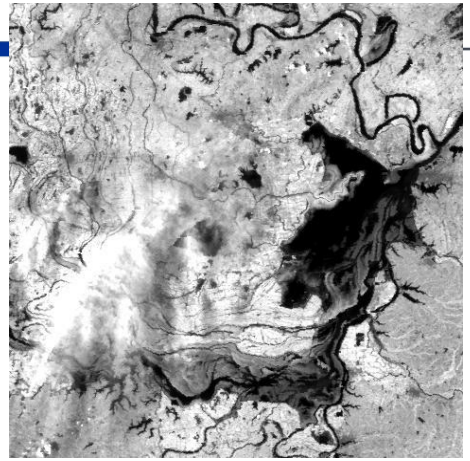
FY-3D/MERSI-II

No.	Center wavelength	Bandwidth	Spatial Resolution
1	412 nm	20 nm	1000 m
2	443 nm	20 nm	1000 m
3	470 nm	50 nm	250 m
4	490 nm	20 nm	1000 m
5	550 nm	50 nm	250 m
6	555 nm	20 nm	1000 m
7	650 nm	50 nm	250 m
8	670 nm	20 nm	1000 m
9	709 nm	20 nm	1000 m
10	746 nm	20 nm	1000 m
11	865 nm	20 nm	1000 m
12	865 nm	50 nm	250 m
13	905 nm	20 nm	1000 m
14	936 nm	20 nm	1000 m
15	940 nm	50 nm	1000 m
16	1240 / 1030 nm	20 nm	1000 m
17	1380 nm	20 / 30 nm	1000 m
18	1640 nm	50 nm	1000 m
19	2130 nm	50 nm	1000 m
20	3.80 μm	0.18 μm	1000 m
21	4.05 μm	0.155 μm	1000 m
22	7.20 μm	0.50 μm	1000 m
23	8.55 μm	0.30 μm	1000 m
24	10.8 μm	1.0 μm	250 m
25	12.0 μm	1.0 μm	250 m

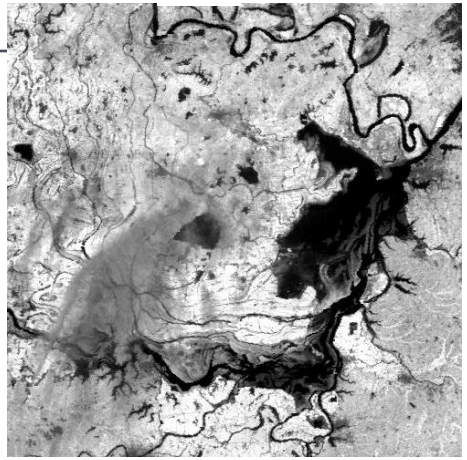
3、4、2 composite image



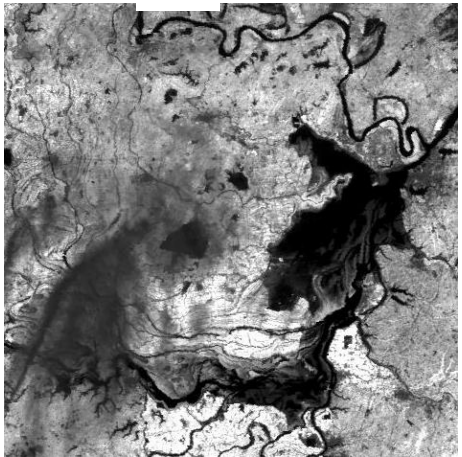
Single band



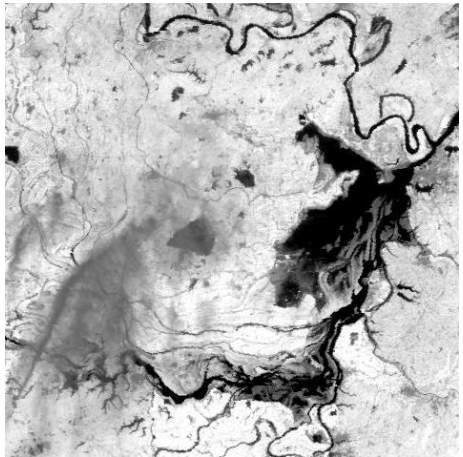
DI



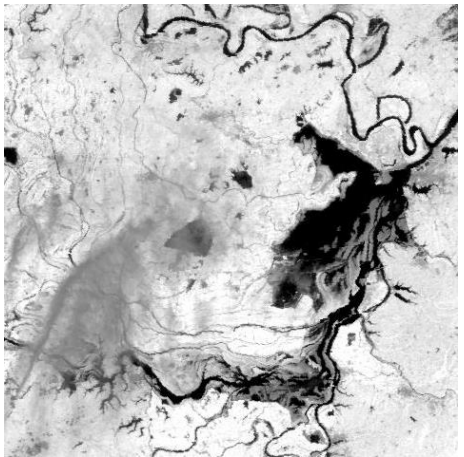
RI



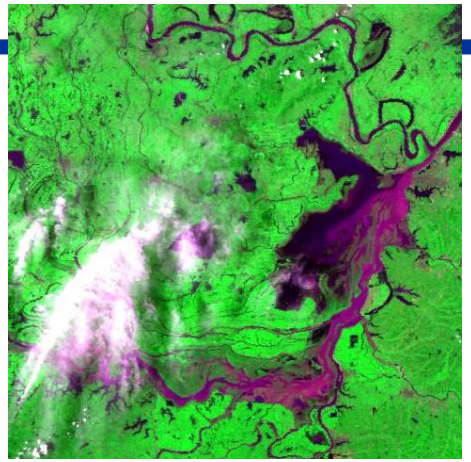
NDVI



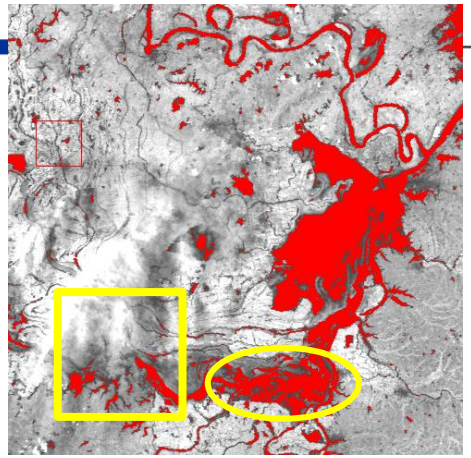
NDWI



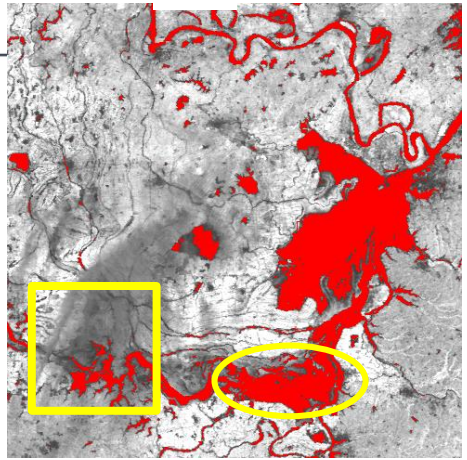
3、4、2 composite image



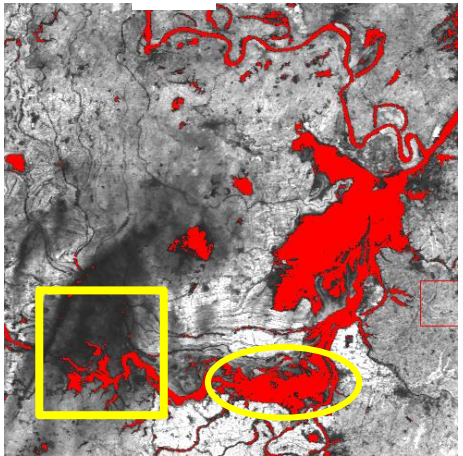
Single band



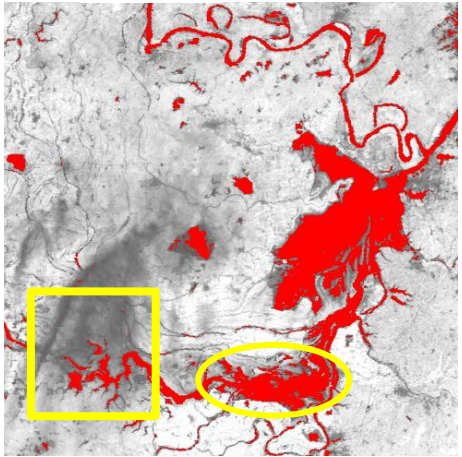
DI



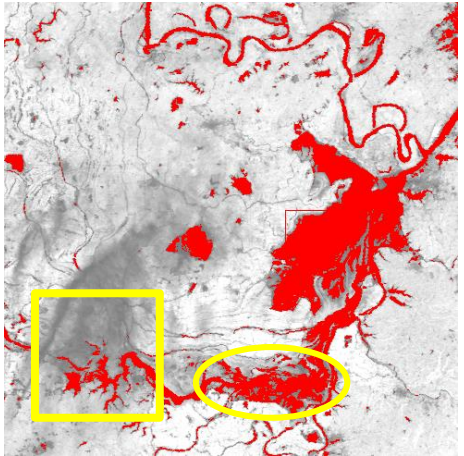
RI



NDVI

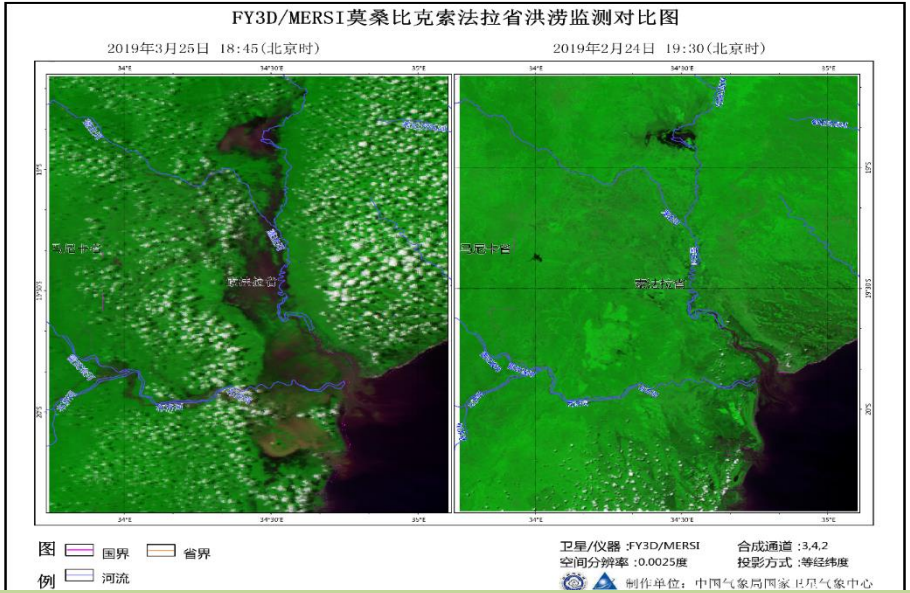


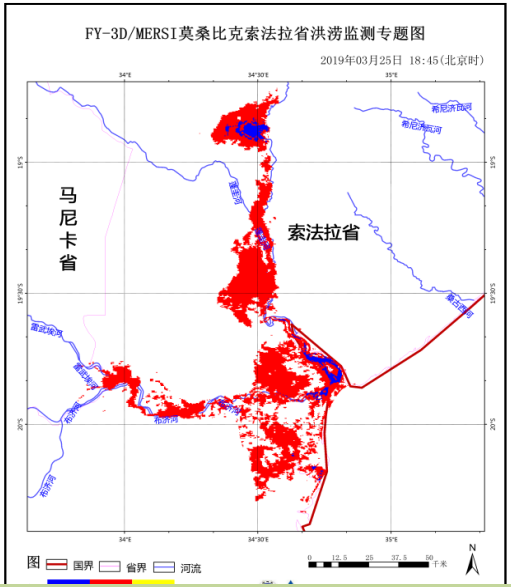
NDWI



Monitoring flood based on FY satellites data

When the severe flood happened in China, One Belt And One Road region and other countries, the FY satellite data will be tried to detect flood. The flood mapping products will be provided to relative countries .



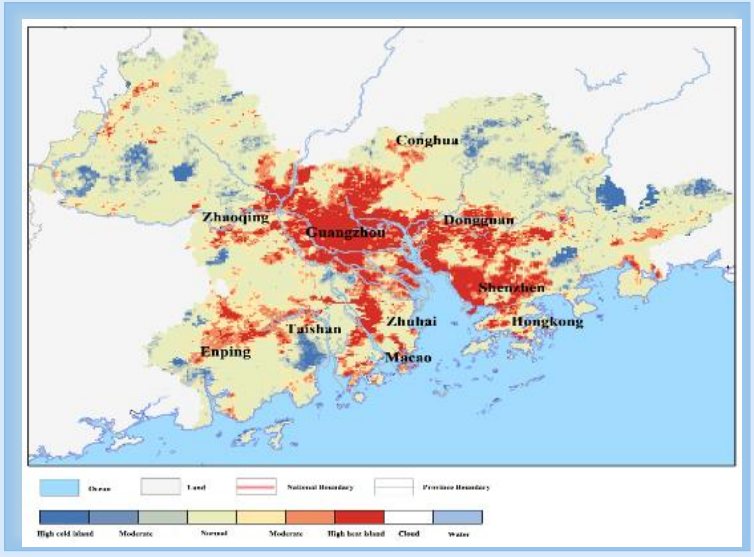


On the evening of March 14, super typhoon Idai landed on the central coast of Mozambique, causing extensive flooding in central Mozambique.

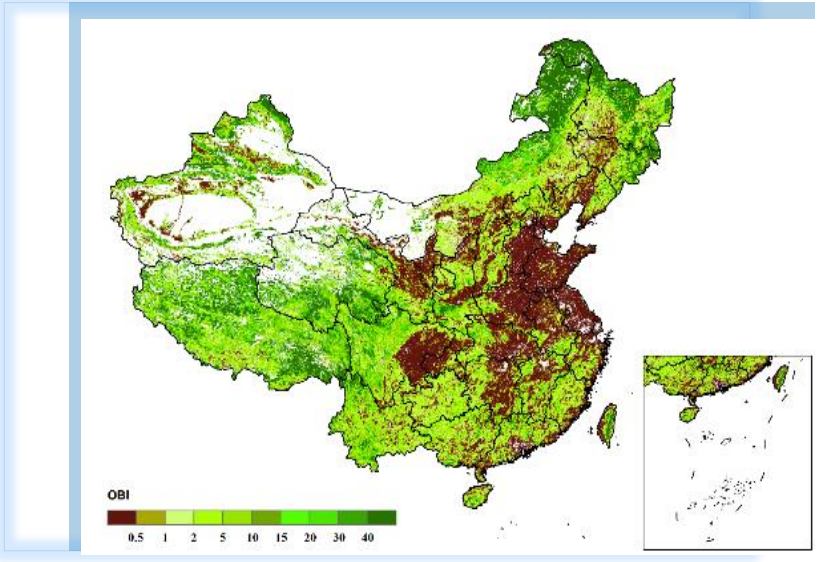
The flood mapping based on FY-3D satellite on showed that a large number of new water bodies appeared in the the Penggui and Niyandukai rivers

Applications：Environment Monitoring

Urban Heat Island



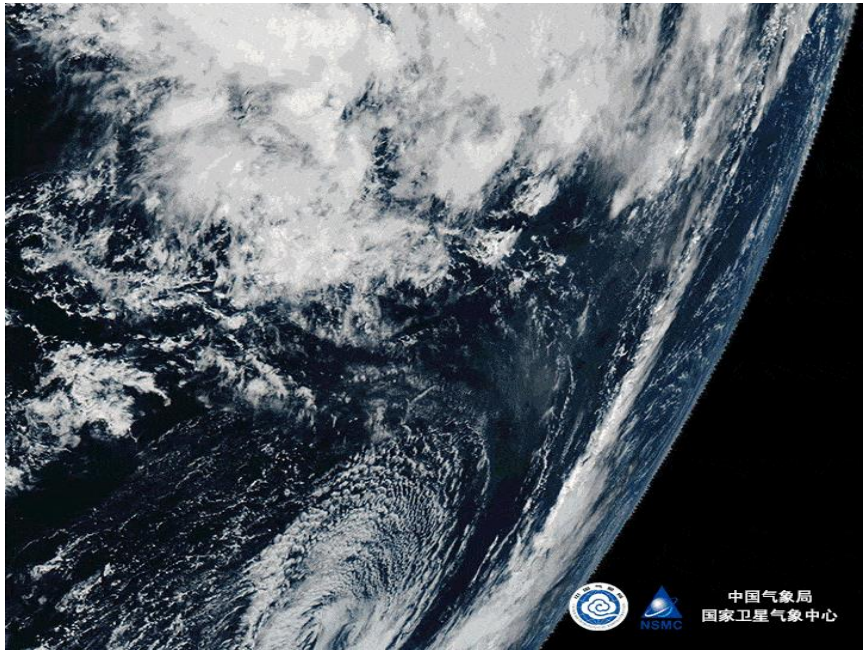
Oxygen Balance

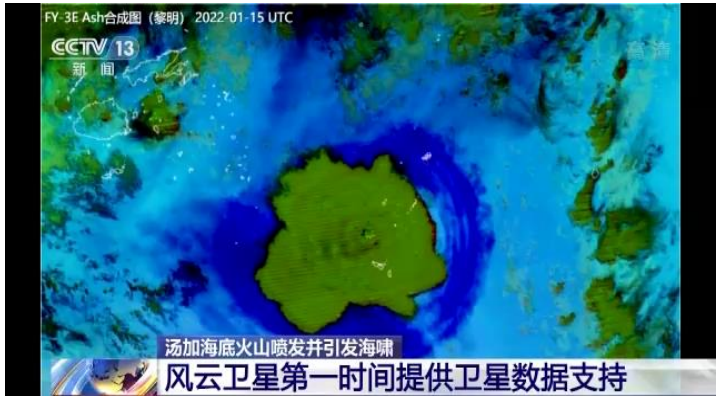


Applications：Natural Disaster

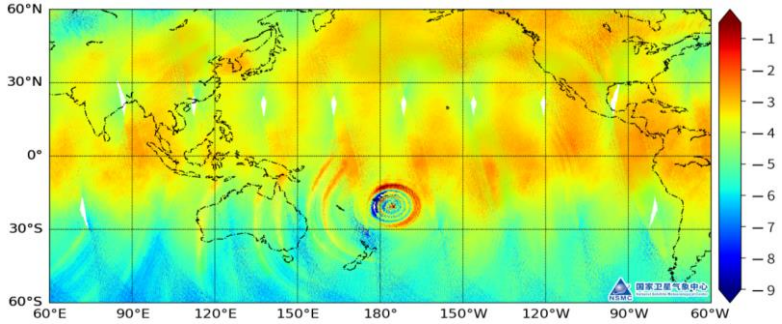
The Volcano Eruption Monitoring over Tonga

- The FengYun satellite have observed volcano eruption, we also provide volcanic ash transmission and atmospheric gravity waves monitoring services.





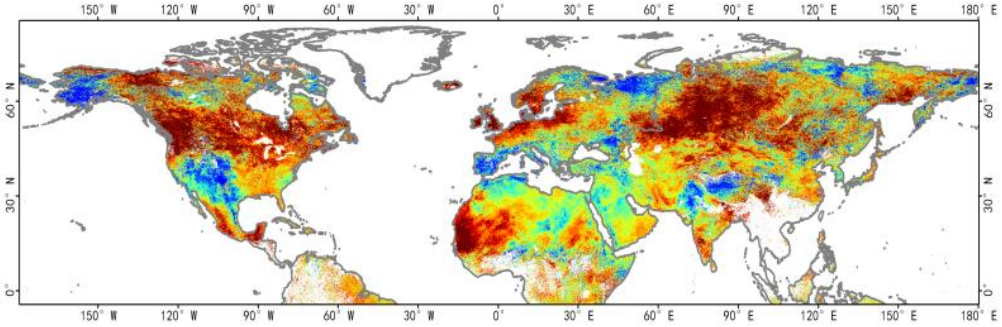
FY-3E volcanic ash and shock wave monitoring



Applications：Environment Monitoring

Heat wave Monitoring

- FY-3D satellite monitoring results shows that since June, the temperature in the northern hemisphere has been generally higher than the average temperature of the same period last year, and that caused wild fires in many parts of North America and Eurasia.



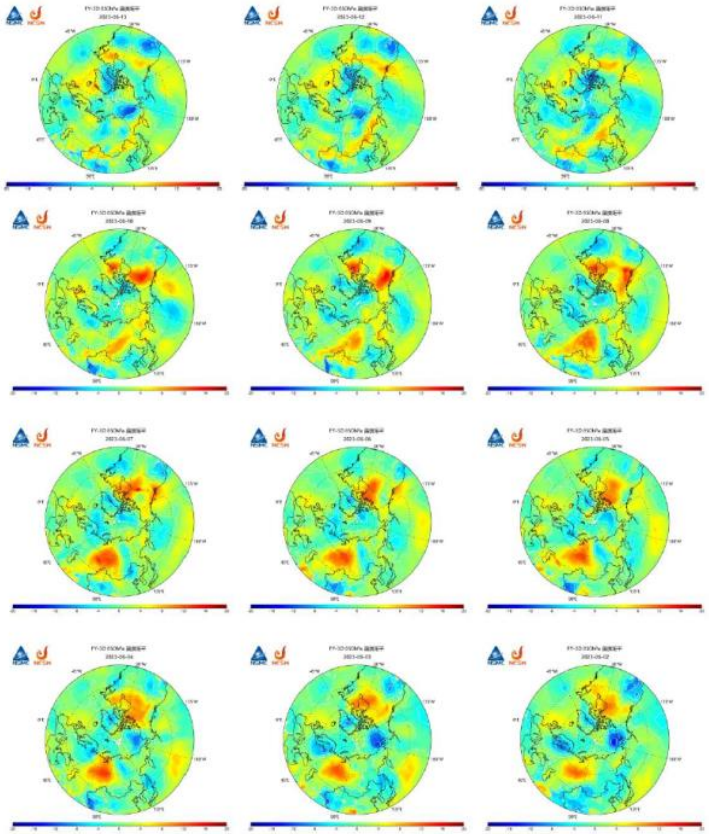
Land Surface Temperature Map of the Northern Hemisphere
June 1-13, 2023

图 陆表温度距平（℃）

例 -10 -8 -6 -4 -2 0 2 4 6 8 10

卫星/仪器：FY3D/MERSI
空间分辨率：1000米
投影方式：GLL

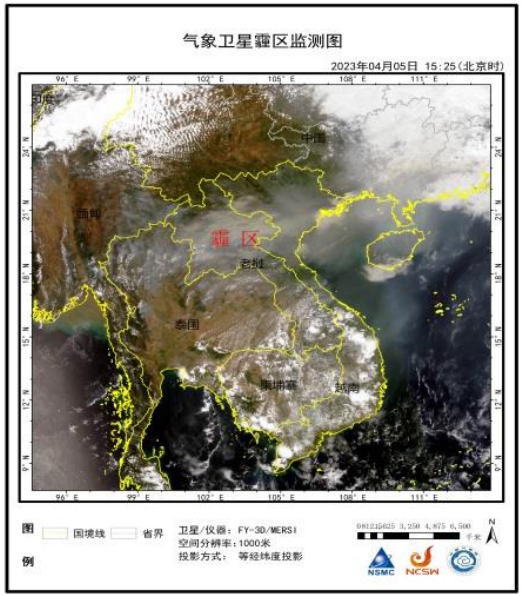
NSMC NCSW N

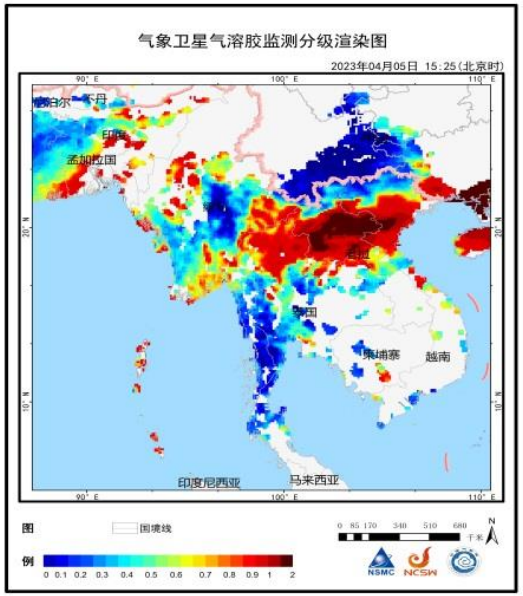


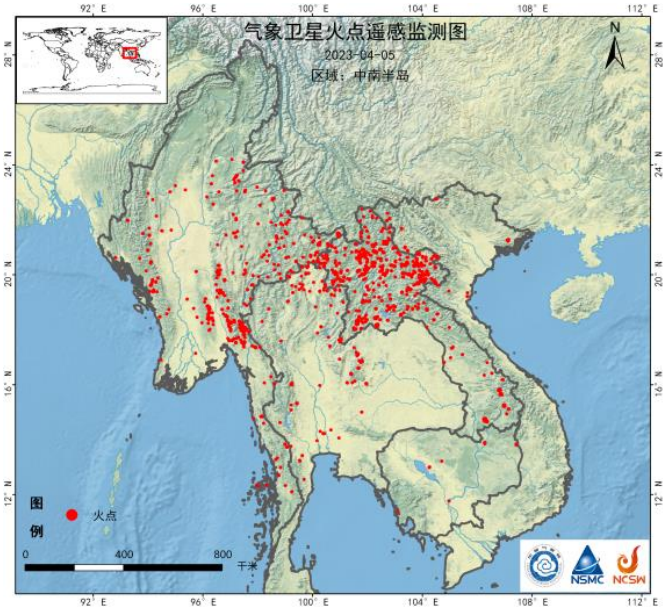
Applications：Environment Monitoring

The Haze Monitoring in Southeast Asia

- FY-3D satellite monitored the serious haze caused by the continuous biomass burning, the haze smoke were mainly appeared in northern Laos, in early April, 2023.



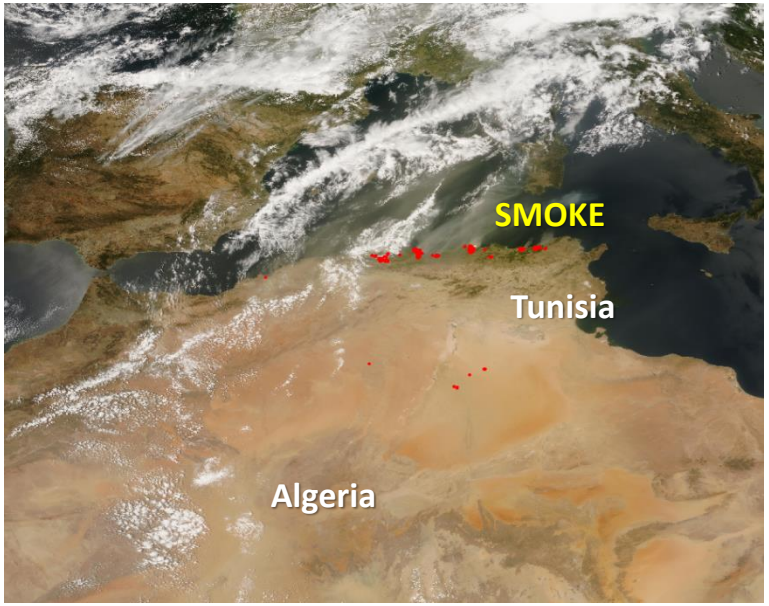


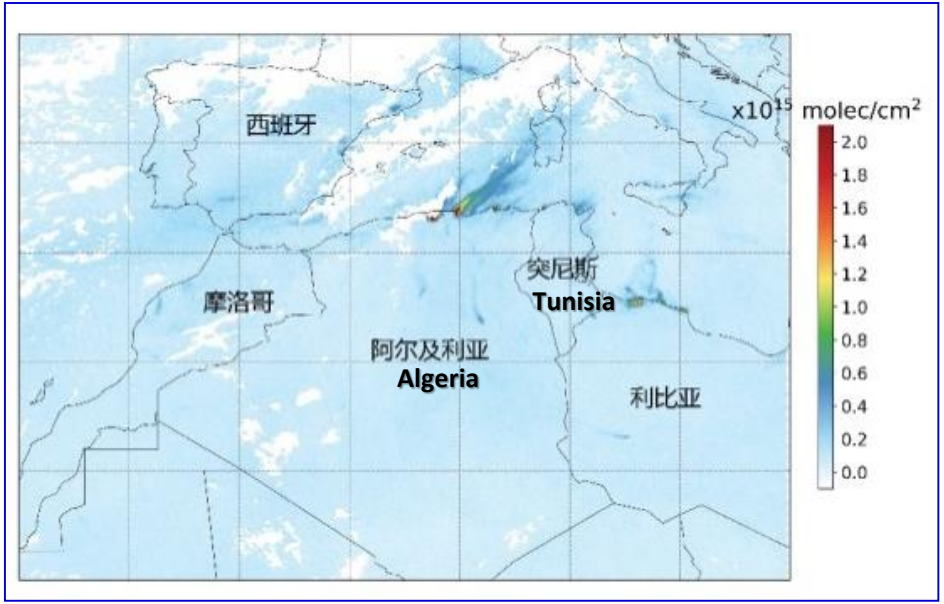


Applications：Natural Disaster

Wild Fire Monitoring in Algeria and Tunisia

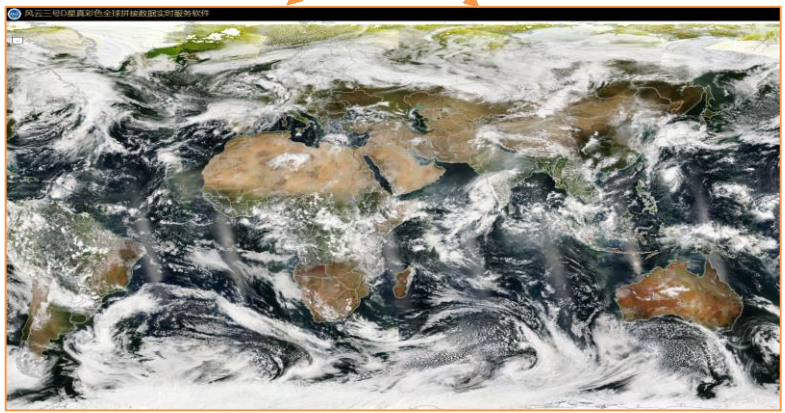
FY-3D made close monitor of dense fires along the coast of Algeria, extended into northwestern Tunisia.



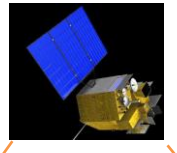


Current wildfire monitoring capability

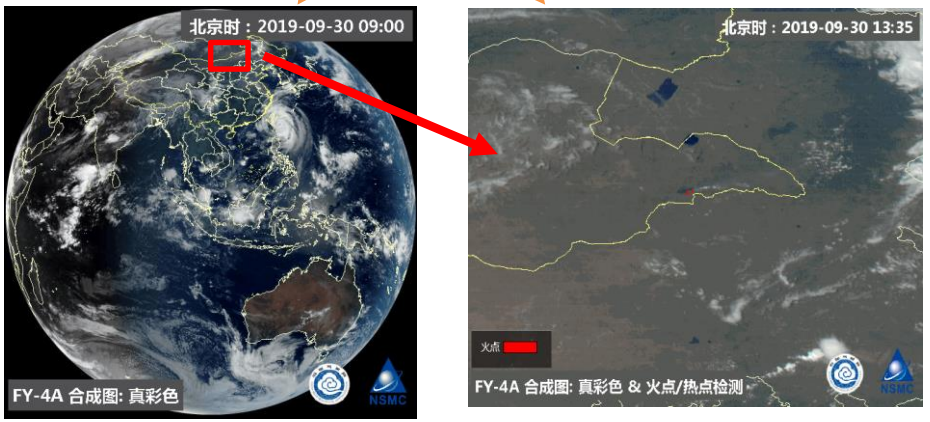
FY-3D,E,F



250-m spatial resolution at global scale



FY-4A,B



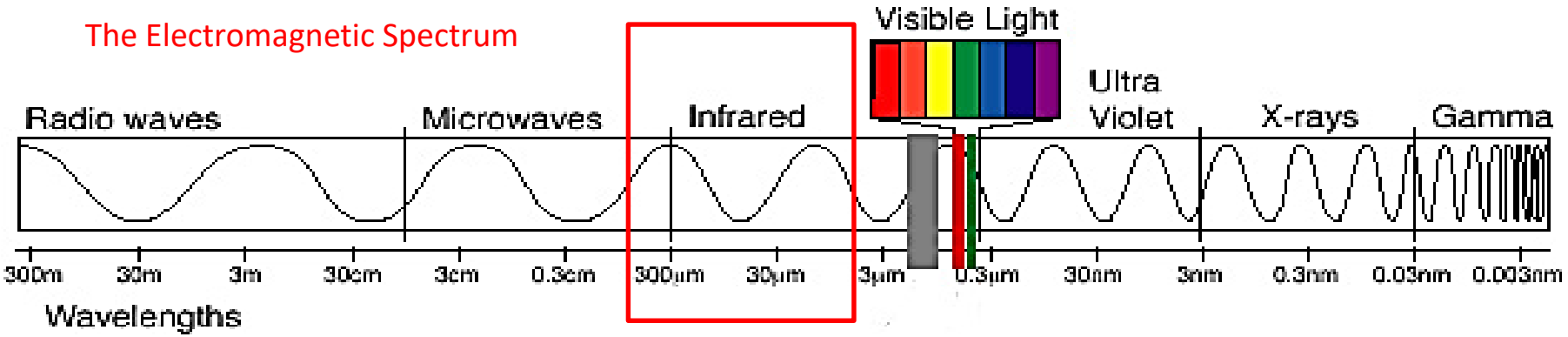
24-hour continuous dynamic monitoring

FY-3 and FY-4 as the second generation of Chinese meteorological satellite , the spatial, temporal and spectral resolution improved largely. The fire monitoring capability has been enhanced greatly. More accurate and timely fire products can be generated. Especially in global application, FY become the most important data in NSMC.

- ✓ **High response time**
- ✓ **High positioning accuracy**
- ✓ **High monitoring frequency**

The method of wildfire detection

Theory and method for wildfire detection



- Remote sensing uses the radiant energy that is reflected and emitted from Earth at various “wavelengths” of the electromagnetic spectrum;

- The satellite infrared channel is very sensitive to the hotspots on the earth.

The method of wildfire detection

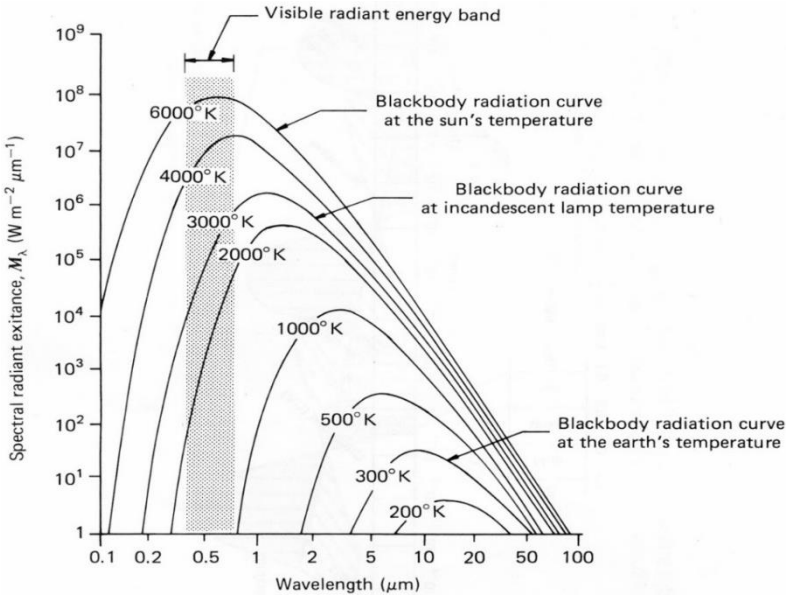
Planck's Radiation Law describes the amount of emitted energy per wavelength depending on the objects temperature:

$$M_{\lambda,T} = \frac{C_1}{\lambda^5\left[e^{\left(\frac{C_2}{\lambda T}\right)} - 1\right]},$$

where $M_{\lambda,T}$ is the spectral radiant emittance in (W m^{-3}), λ is the wavelength in (m), T is the absolute temperature in (K), C_1 is the first radiation constant, $3.74151 \cdot 10^{-16}$ (W m^2) and C_2 is the second radiation constant, 0.01438377 (mK).

For very hot surfaces (e.g. the sun), the peak of the blackbody curve is at short wavelengths. For colder surfaces, such as the earth, the peak of the blackbody curve moves to longer wavelengths.

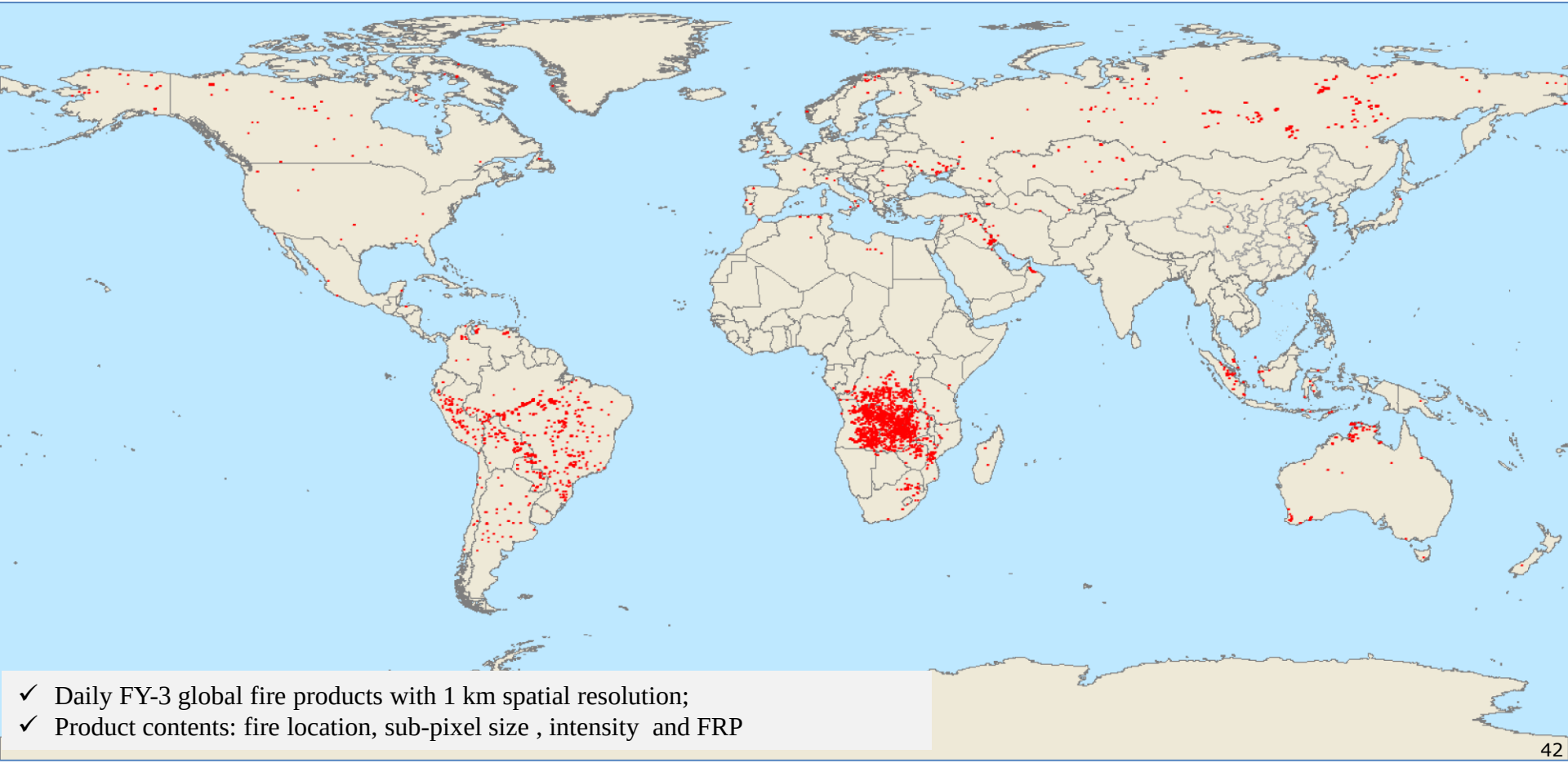
This behavior described by Wien's displacement law



$$\lambda_{max} = \frac{2898}{T}$$

where λ_{max} is the wavelength of the radiation maximum in (μm), T is temperature in (K) and 2898 is a physical constant in (μm).

Daily global wildfire product of FY-3D
(On 21 August,2019)



- ✓ Daily FY-3 global fire products with 1 km spatial resolution;
- ✓ Product contents: fire location, sub-pixel size , intensity and FRP

Monthly global wildfire accumulation product using FY-3D (In August,2019)

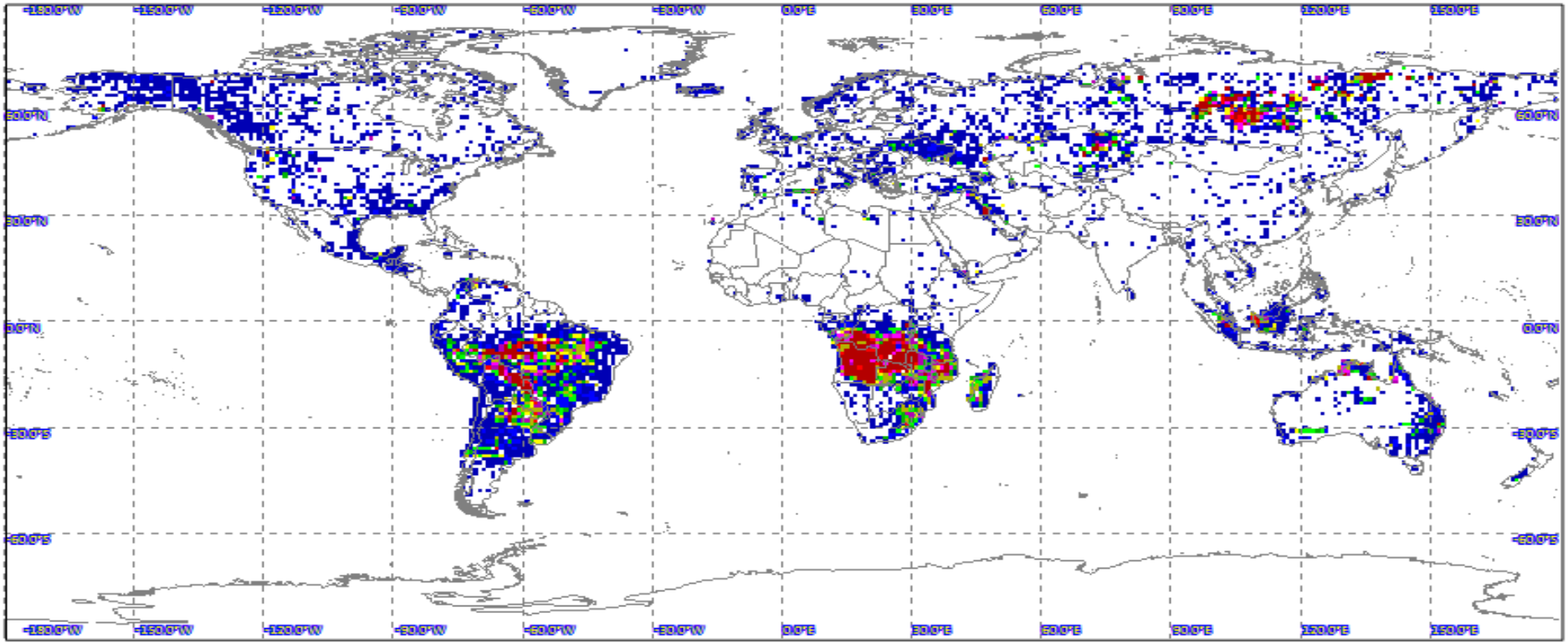
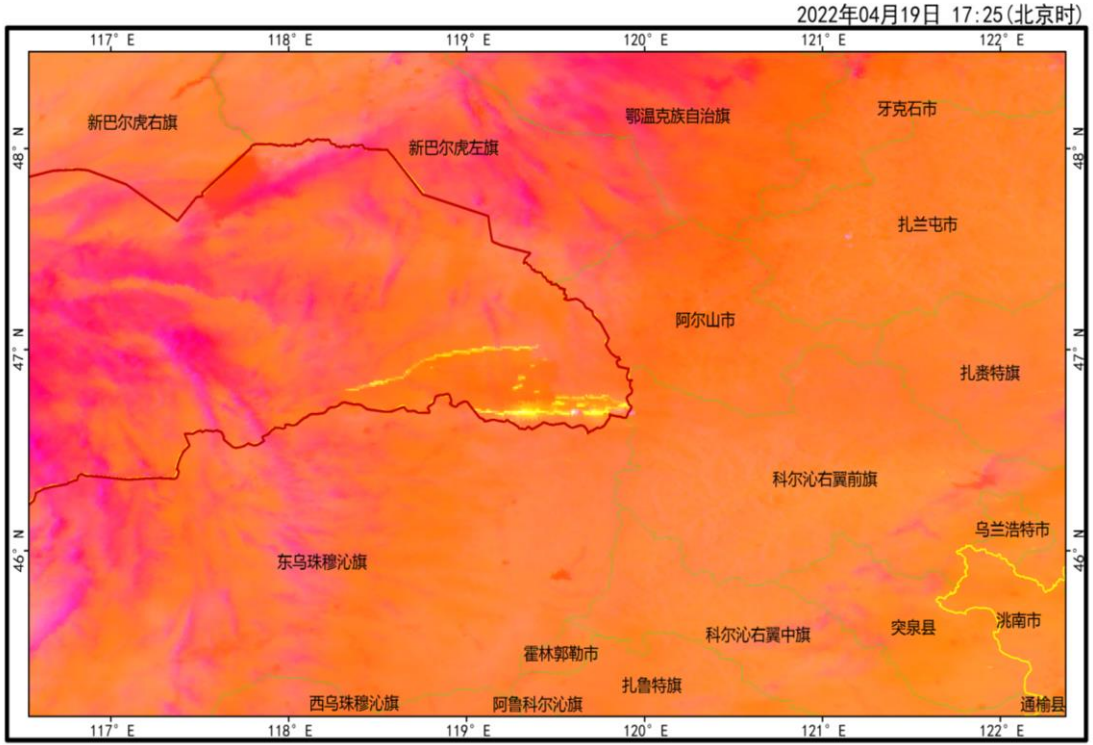


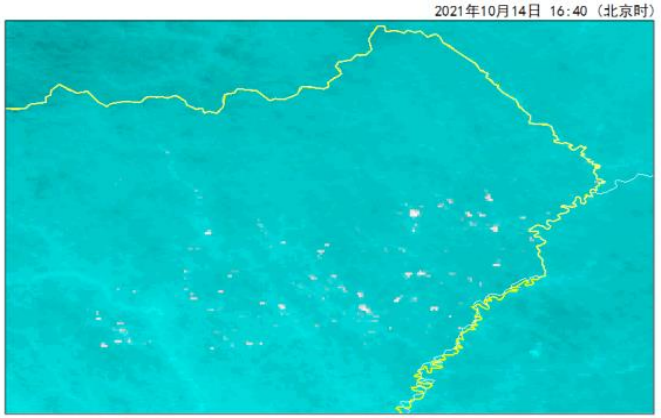
图 例

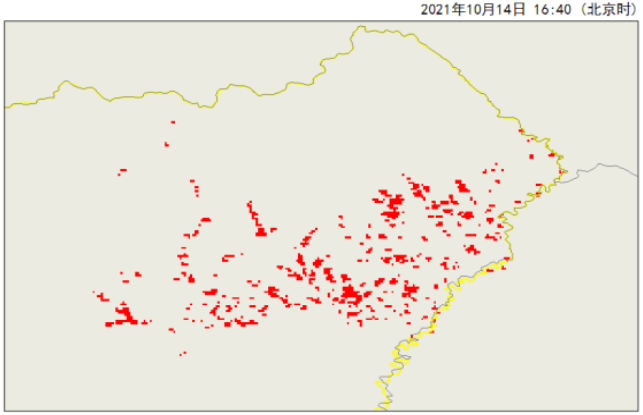
1 20 40 60 80 100 150 200 250 300 (个)

中国气象局 国家卫星气象中心 NSMC

FY-3E Early Morning satellite fire monitoring

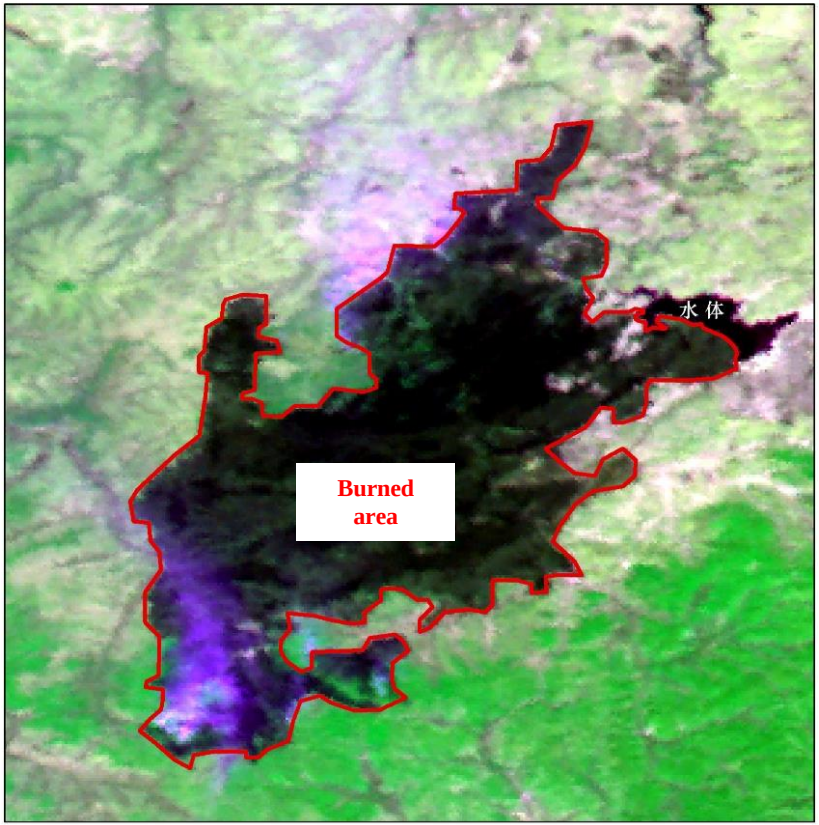


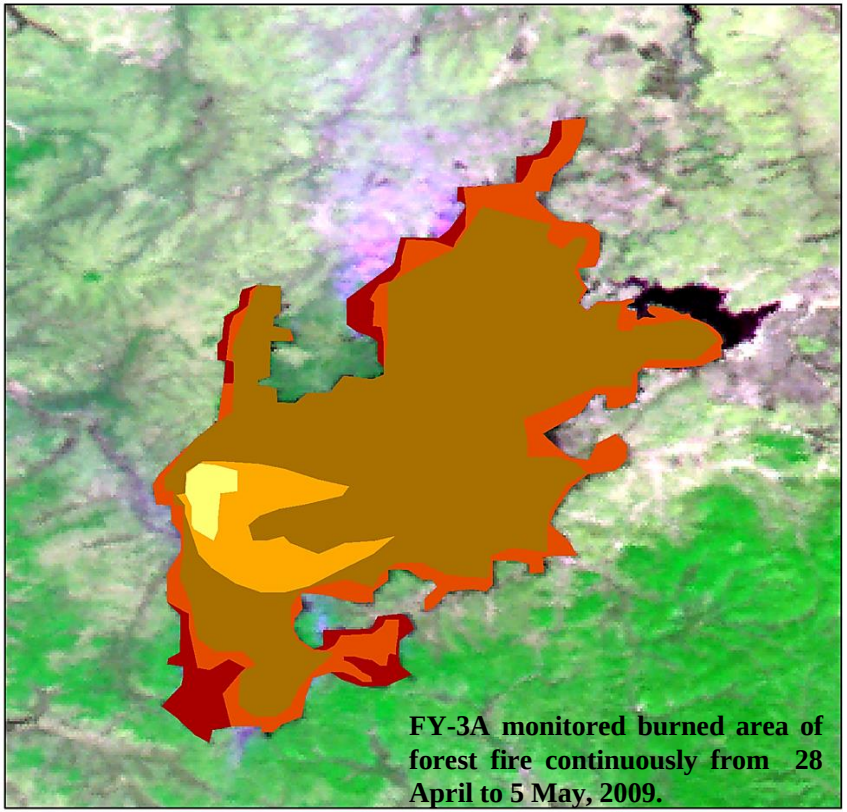


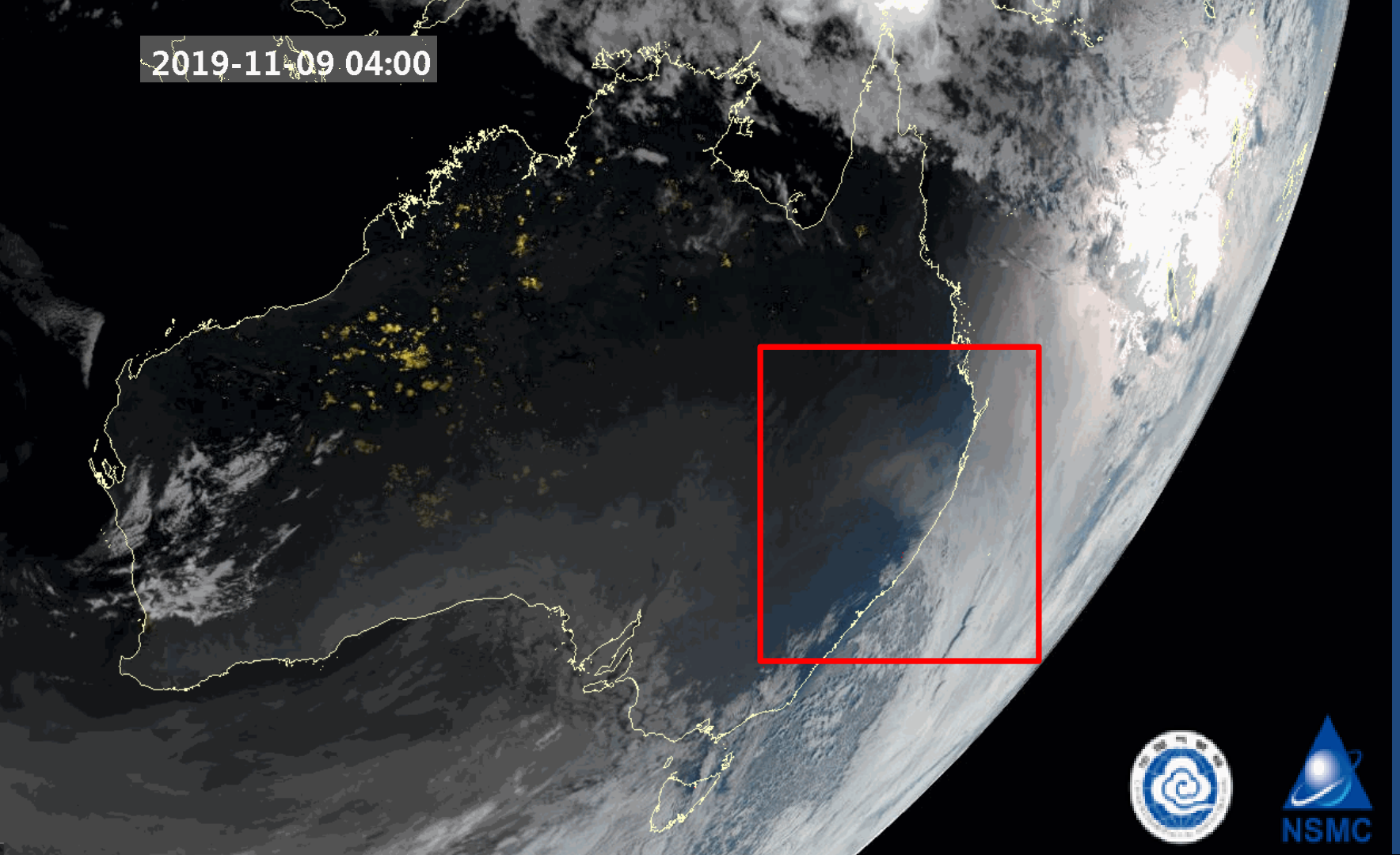


Burned area estimation based on FY data

FY-3A monitored burned area of forest fire in the northeast of China
5 May , 2009



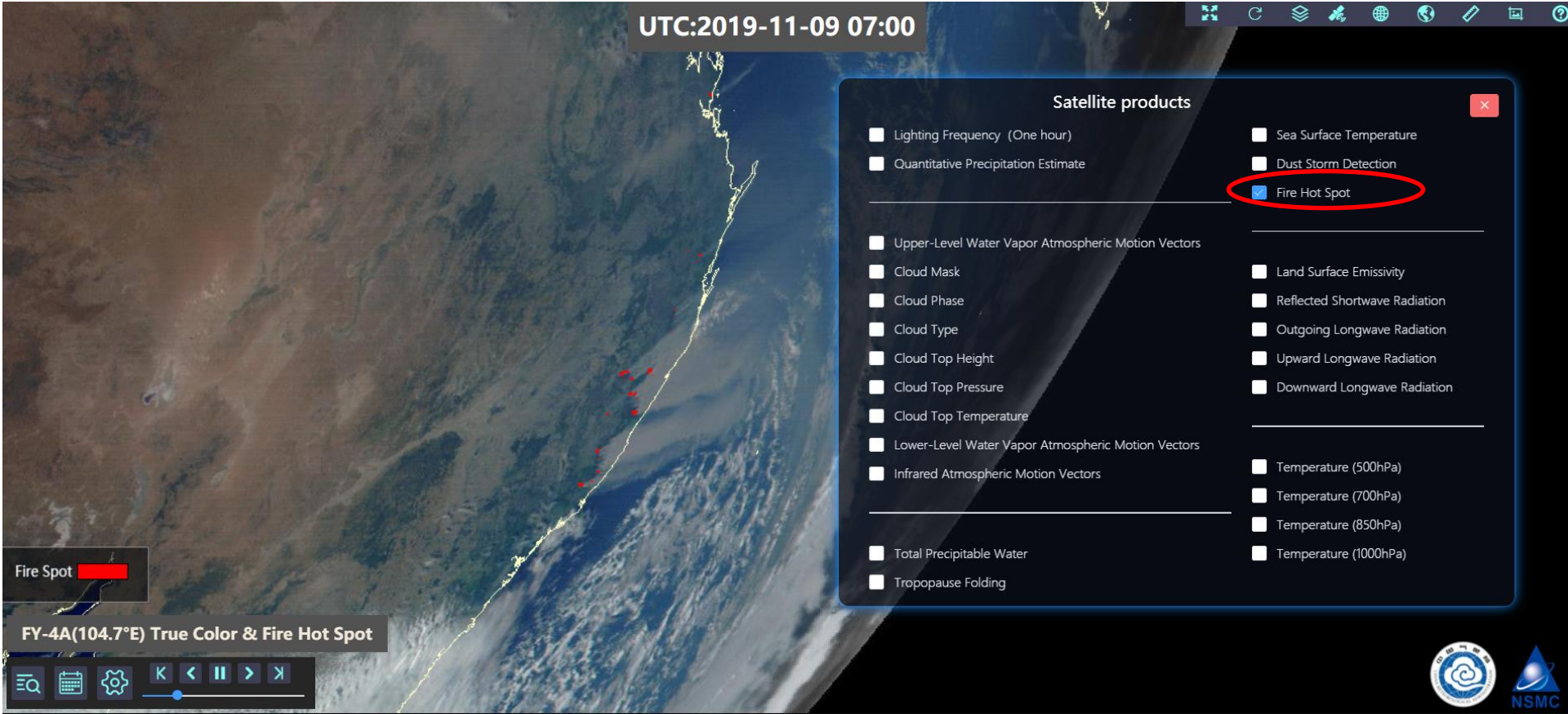



2019-11-09 04:00
NSMC

Wildfire product tools

SWAP online

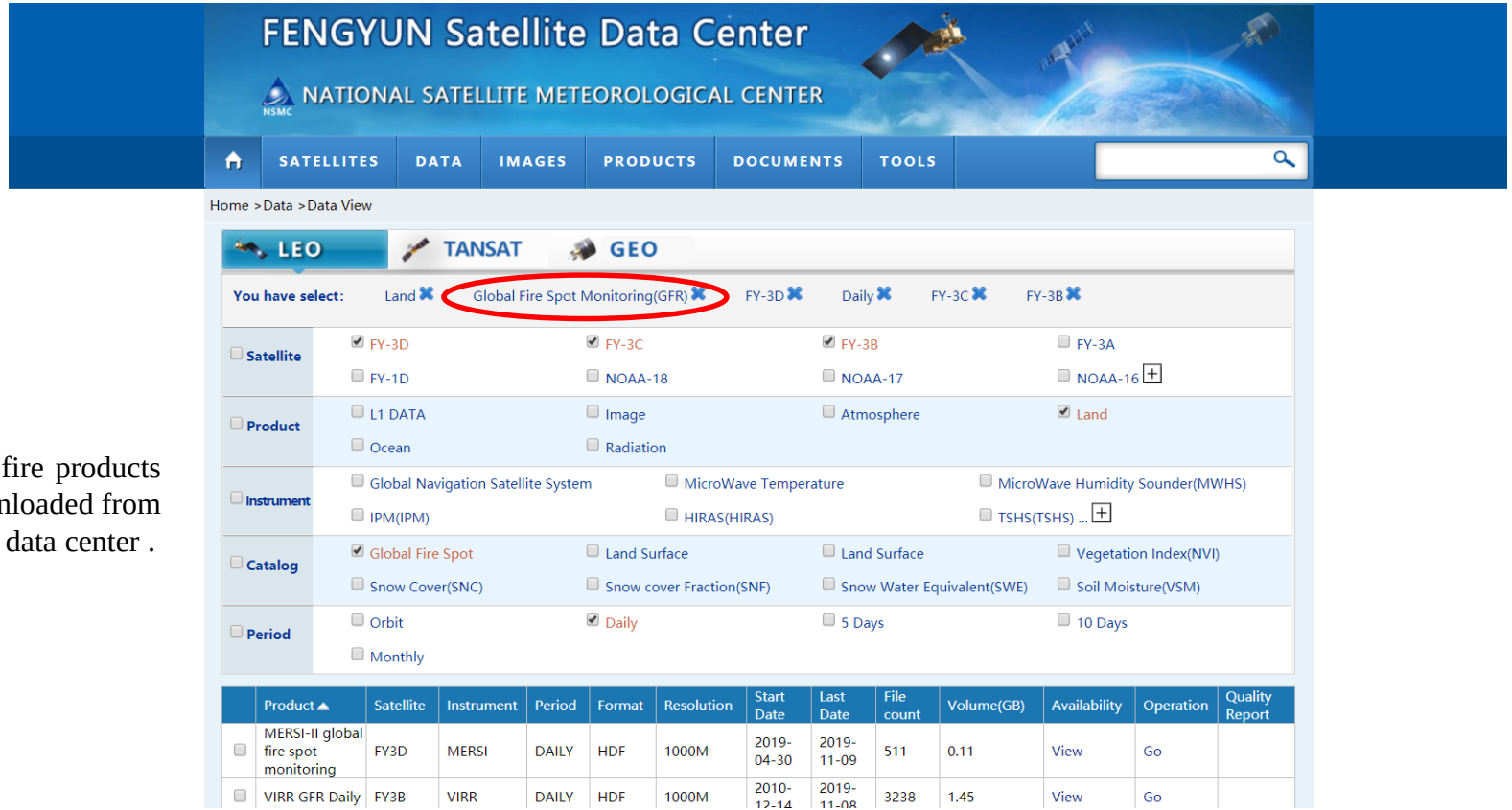
http://rsapp.nsmc.org.cn/geofy/en



Wildfire product tools

FENGYUN satellite data center

http://satellite.nsmc.org.cn/PortalSite/Default.aspx



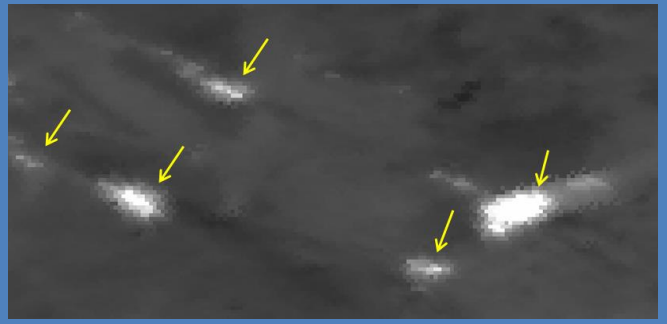
FY-3 daily fire products can be downloaded from FY satellite data center .

New method research for wildfire detection

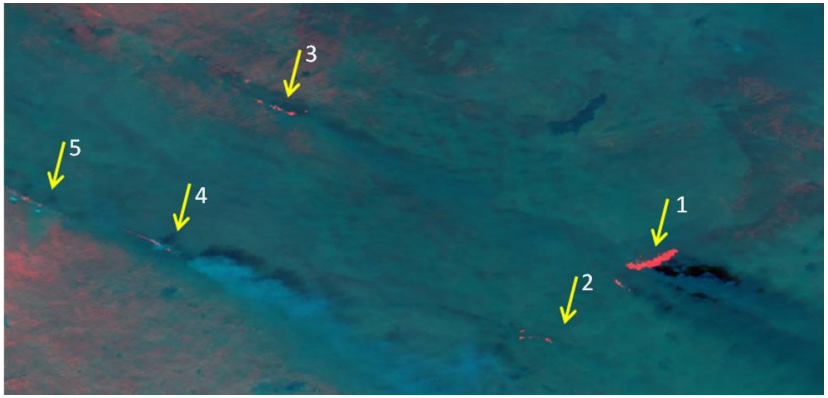
Combining FY-3D/MERSI-II far-infrared and mid-infrared data

FY-3D/MERSI-II have 250m resolution in far-infrared channels, which can provide more accurate position and intensity information.

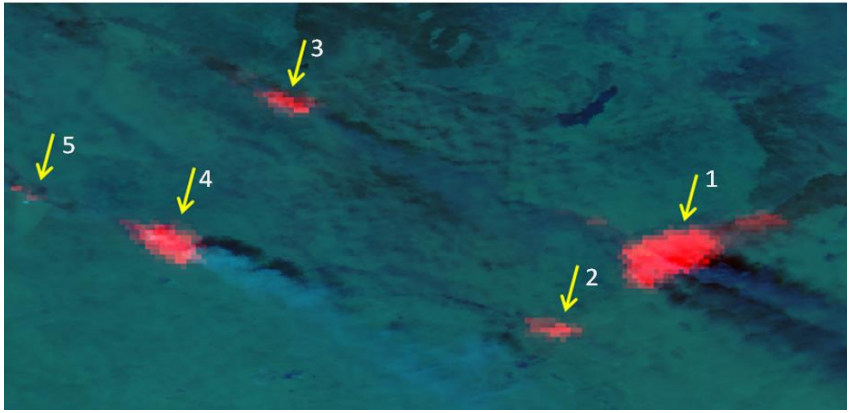
FY-3D/MERSI-II 10.8 um grassland fire image at 04:25 of April 20, 2019



FY-3D/MERSI-II 3.8 um grassland fire image at 04:25 of April 20, 2019



FY-3D/MERSI-II 10.8μm，0.86μm and 0.65μm composite image at 04:25 of April 20, 2019



FY-3D/MERSI-II 3.8μm，0.86μm and 0.65μm composite image at 04:25 of April 20, 2019

Wildfire risk prediction

For wildfire prevention to avoid property losses,wildfire risk prediction method is studied based on the long-time series fire information , as well as meteorological observation and forecast information.

$$U_M = I_t(t) + I_f(f) + I_v(v) + I_m(m)$$

t：daily maximum temperature

f：daily minimum relative humidity minimum relative humidity

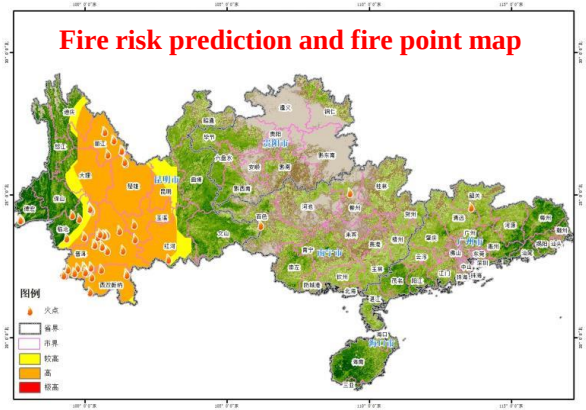
v：daily maximum wind speed

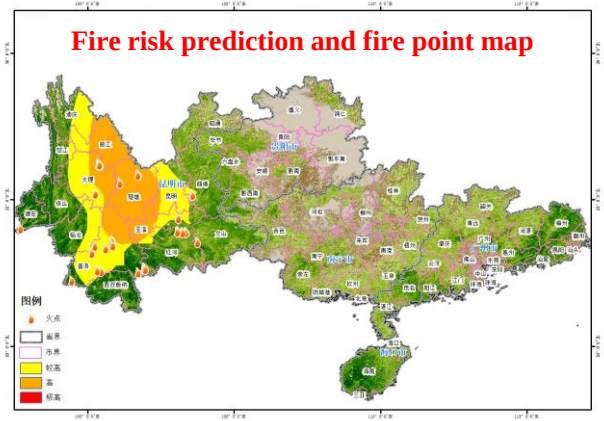
m：daily maximum rainfall and consecutive days without rain

$$F = U_M + I_R(R)$$

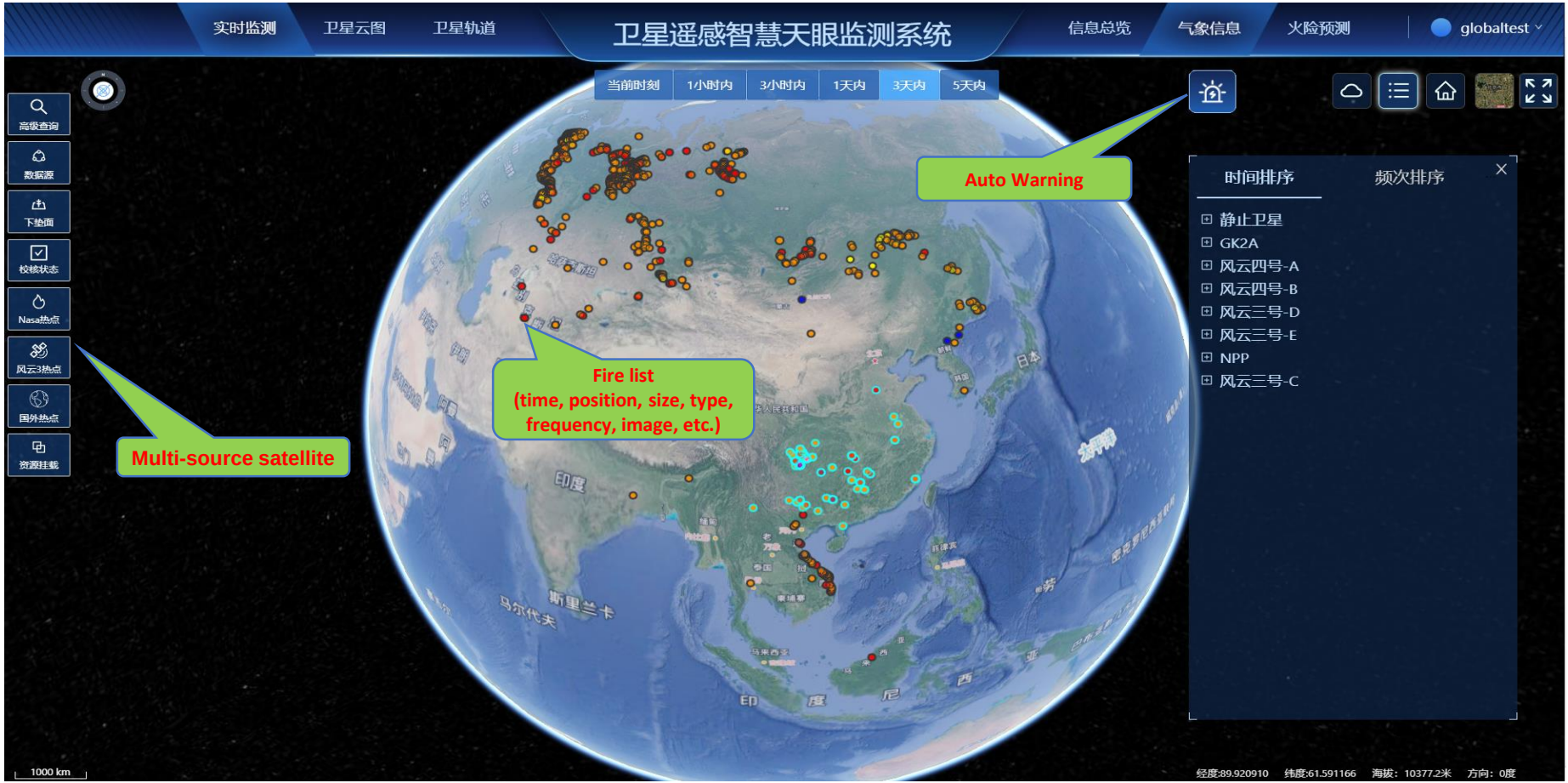
R：fire point statistic from FY satellite data

The prediction method has been applied in South China with good results. The fire point is superimposed on the fire risk prediction area, with high consistency. The method can be extended to other regions.





Satellite real-time fire monitoring intelligent 3D platform

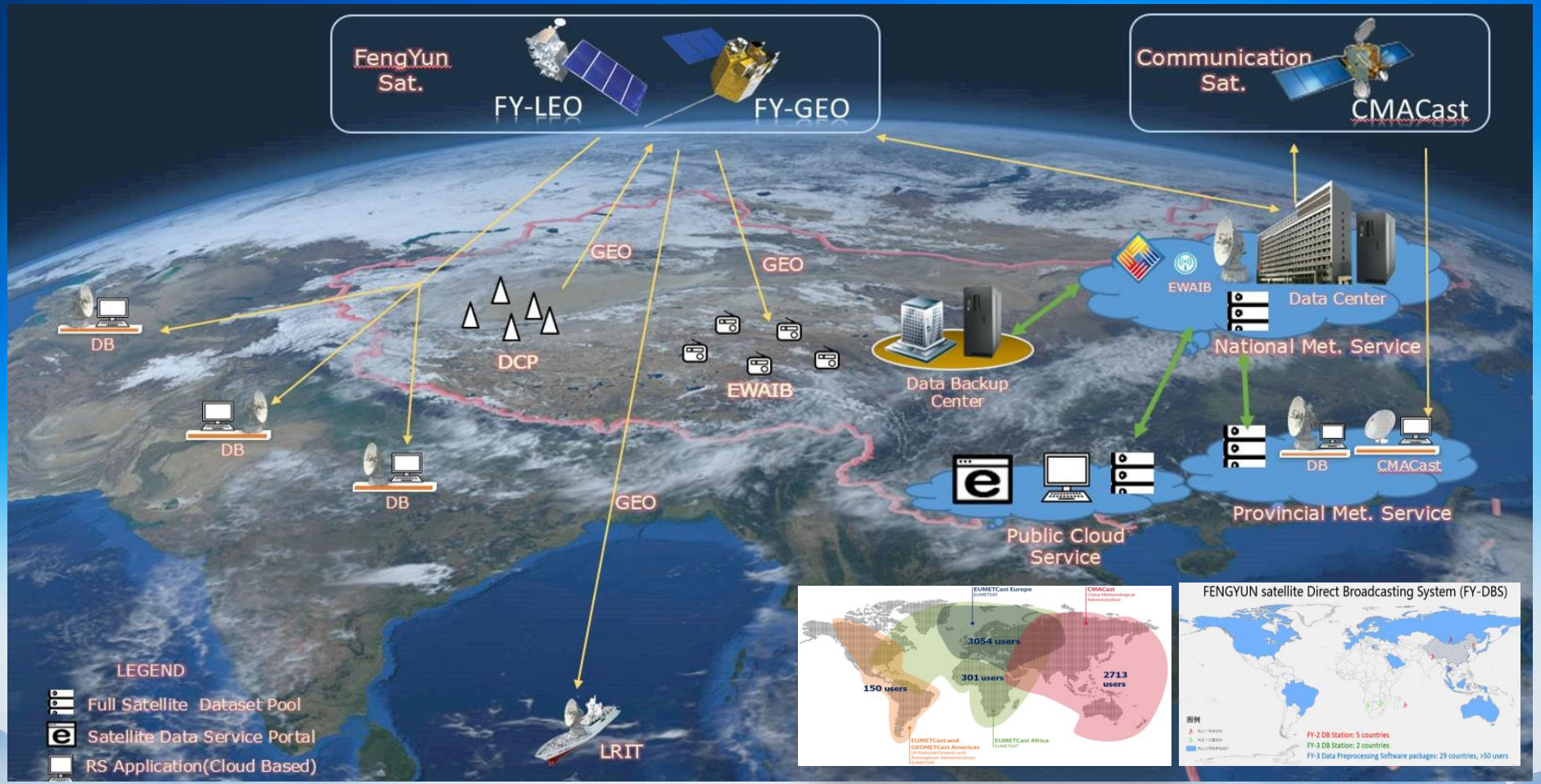


CONTENTS

FengYun Satellite Data Service

Type	User	Time
Website	All user	Non real-time
Direct B roadcast	Agreement user	Real-time
CMAcast（FY-4A, FY-3D)	Agreement user	Real-time
FTP service	All user	Non real-time
Emergency data service	Agreement user	Real-time
GTS /WIS	Agreement user	Non real-time
China-EU data exchange	Agreement user	Non real-time
Manual Service	All user	Non real-time

Data services



Web services

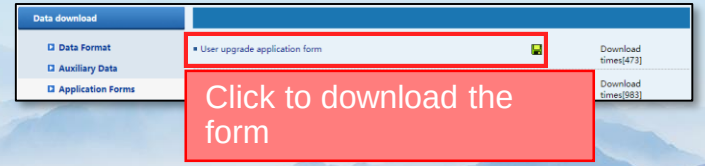
data.nsmc.org.cn/portalsite/

- All 31 PB archived data (incl. real time)
- Satellites' information
- Satellite images browsing
- Documents and tools

User: freely register, update need authorization

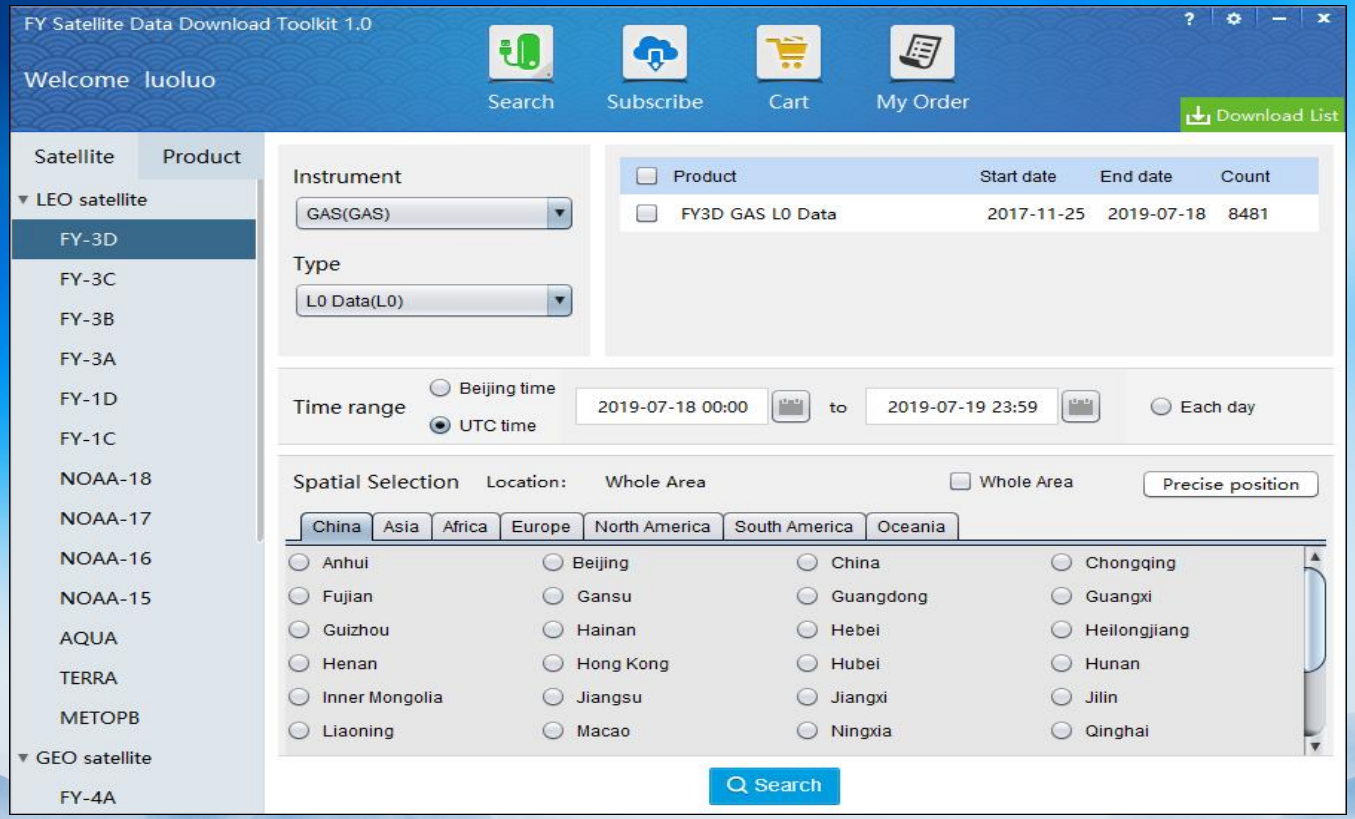
- **Normal: 30GB/day**
- **Senior: 100GB/day**

Application form: https://satellite.nsmc.org.cn/PortalSite/StaticContent/DocumentDownload.aspx?TypeID=8



Windows users

CMA released the FY Satellite Data Download Toolkit



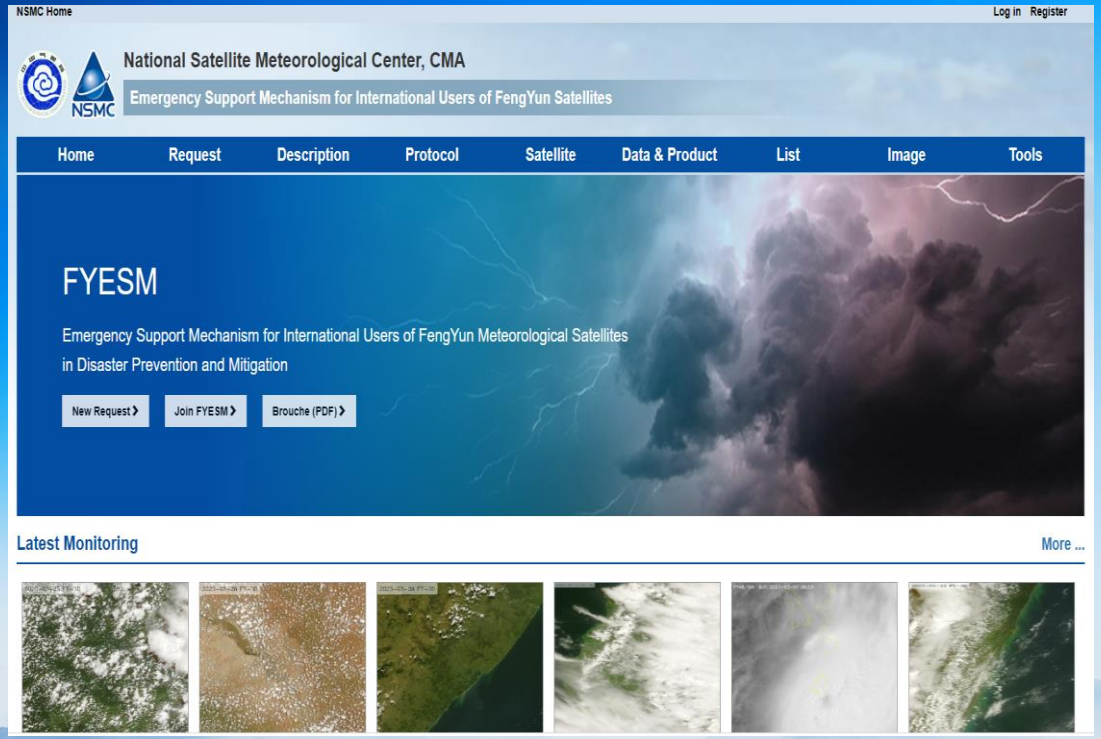
- ✓ **Data Search**
- ✓ **Download Monitor**
- ✓ **Subscribe**
- ✓ **Breakpoint resume**

FY-3 Preprocessing Software Packages

Emergency Users:

Upgrade FY_ESM website and dataflow to support more efficient service.

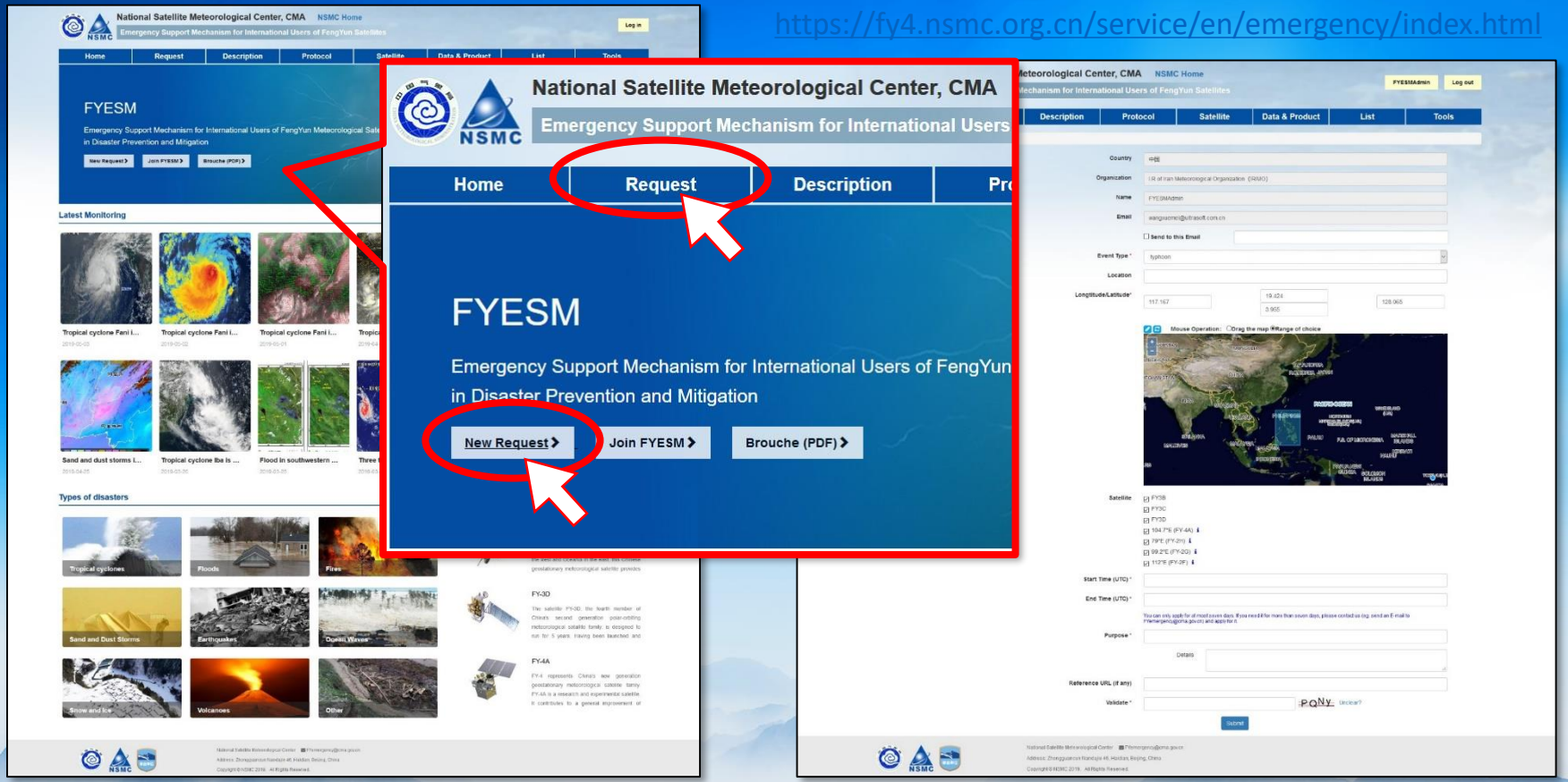
http://www.nsmc.org.cn/service/en/emergency/index.html



CMA introduced the Emergency Support **Mechanism of FENGYUN (FY) Satellite (FY ESM)** to international users who made a request once visited by such extreme events as typhoon, heavy rain, severe convection, forest or grassland fire and sand and dust storm.

Emergency Support Mechanism for International Users of FengYun Satellites

https://fy4.nsmc.org.cn/service/en/emergency/index.html



CONTENTS

FENGYUN EARTH

Comprehensive

Main User: Forecaster

Same underlying **platform**

Integrate resources

Complementary advantages

SWAP

(GEO)

Main User: Meteorologist

SMART

(LEO)

Main User: RS professional

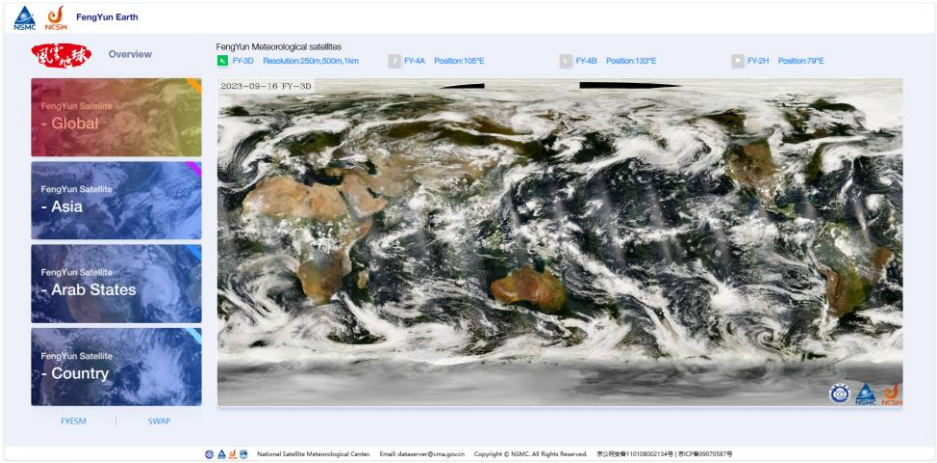
Platforms：FengYun Earth

Comprehensive Cloud Platform
Main User: **Forecaster**
Typical Applications: **Weather Monitoring and Analyzing**

- Build an **integrated meteorological comprehensive product service platform**
- Realize **multi-source, multi-scale, multi-element, multi-form data access**
- Realize **automatic and intelligent processing and analysis of multidimensional data**
- Provide customizable comprehensive meteorological product services by different scale regions such as the **world, Asia, Africa, South America, countries, etc.**

Website

http://fyearth.nsmc.org.cn/



FengYun Earth -UI Design-Homepage

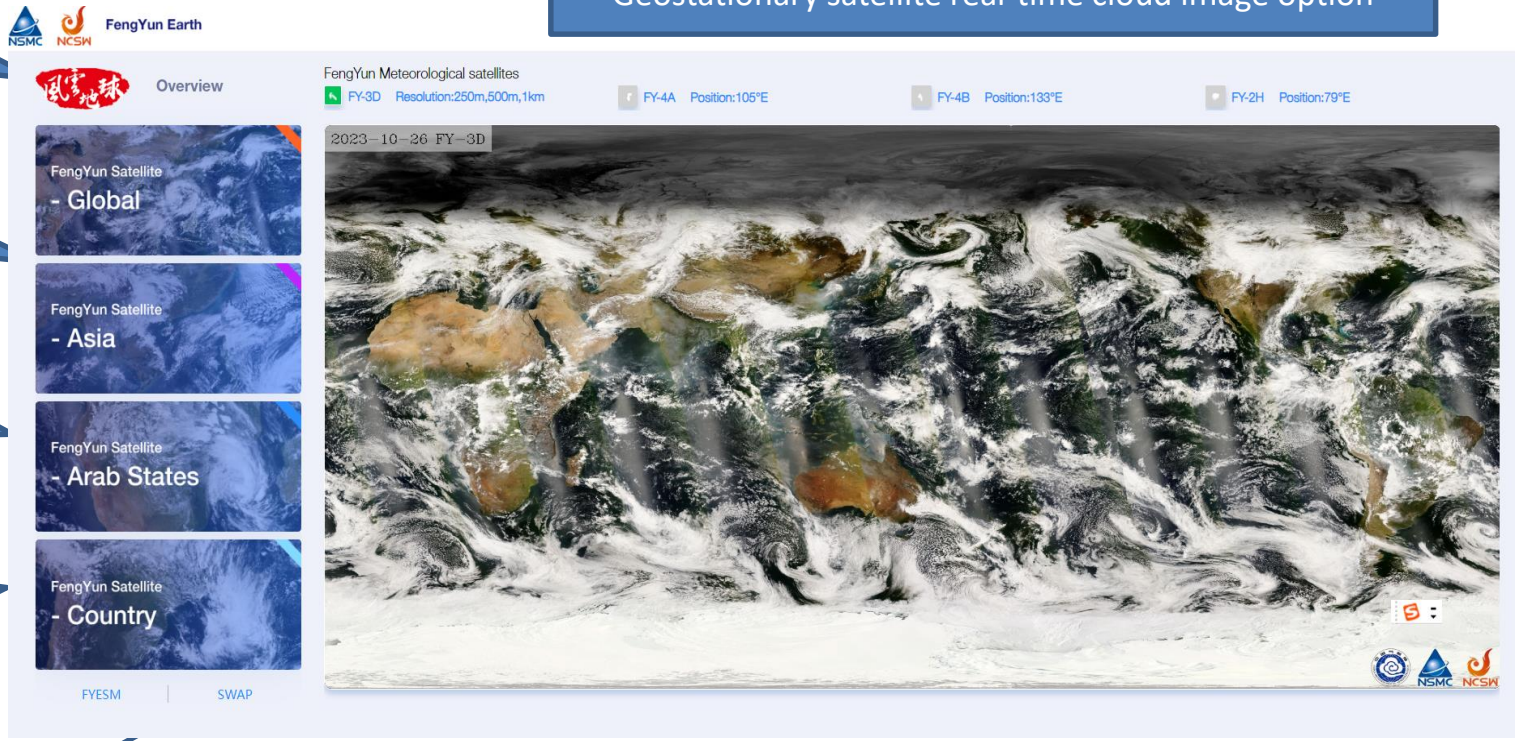
Entrance of global thematic product display

Entrance to thematic product display in Asia

Entrance to thematic product display in Africa

Entrance to thematic product display in South America

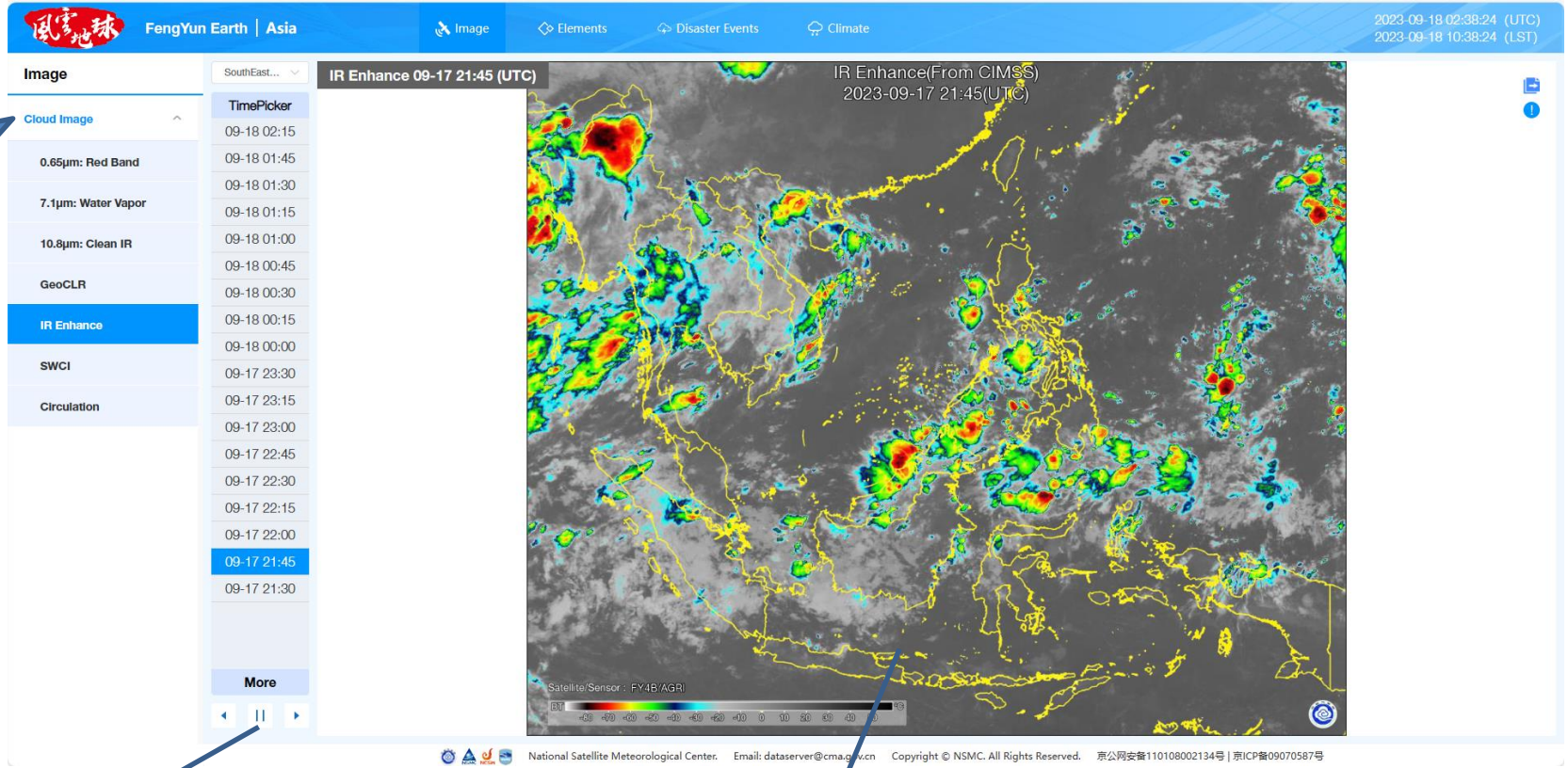
Geostationary satellite real-time cloud image option



external system link

FengYun Earth

Cloud Image Product List



Animation Play Command

Dynamic Thematic Maps

FengYun Earth -Product Page

FengYun Earth | Asia

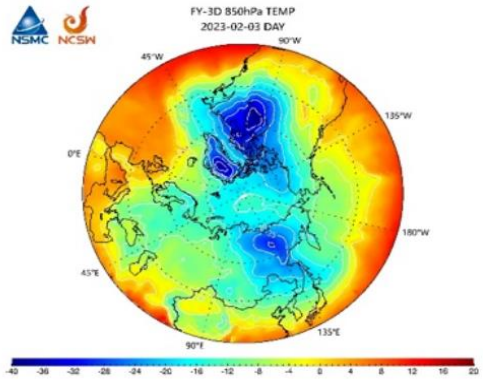
Image | Elements and events | Disastrous weather | Climate | NWP Verification

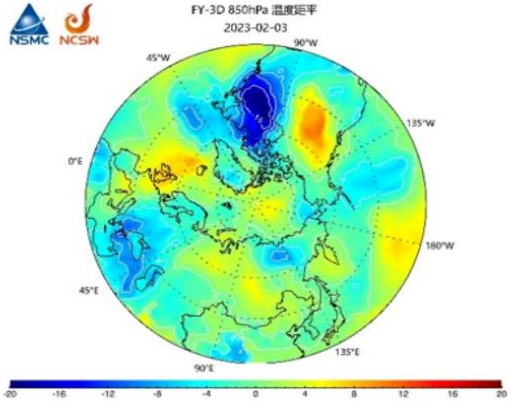
2023-03-16 07:01:59 (UTC)
2023-03-16 15:01:59 (LST)

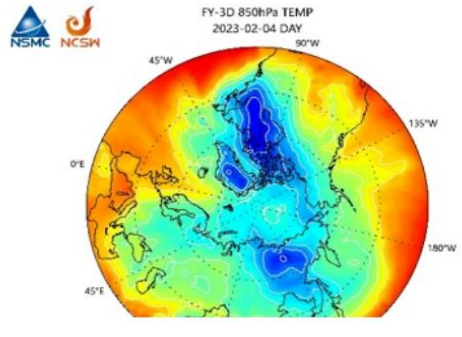
FengYun - asia / Snowstorm / Cold Wave in North America

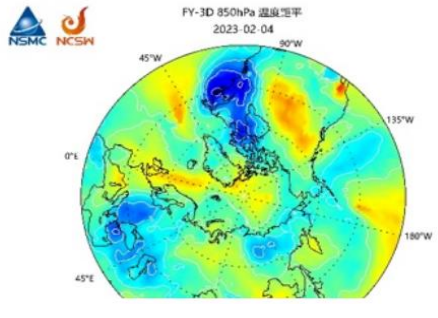
- Air Quality
- Cyclone
- Snowstorm
  - Cold Wave in North America
  - Cold Wave in Europe
  - Atlantic Storm Eunice
  - Snowstorm in the USA
  - Snowstorm in the USA
- Volcano
- Sandstorm
- Ice
- Flood
- Firespot
- Emergency Support
- Ecological
- Drought

Cold Wave in North America

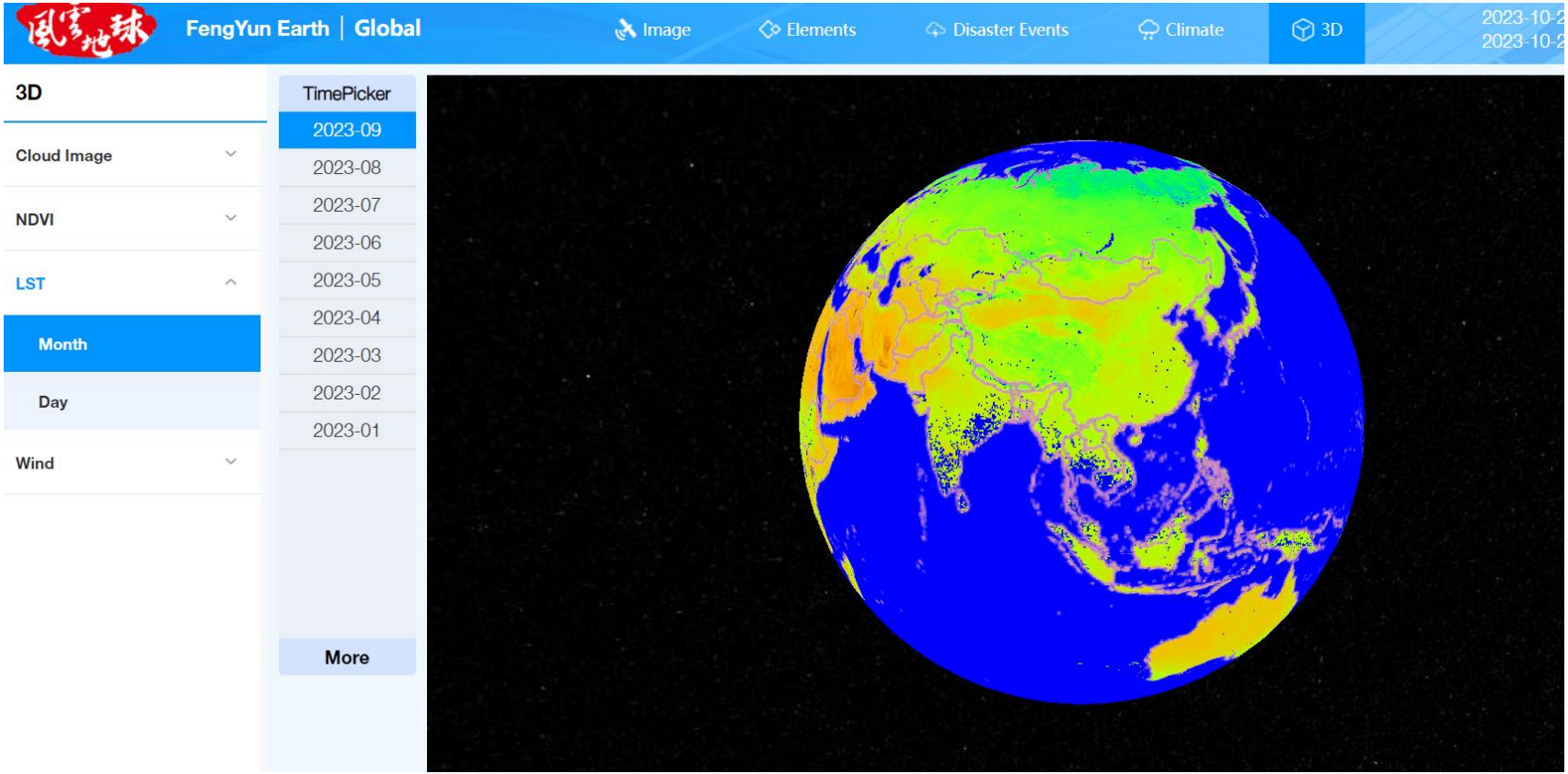




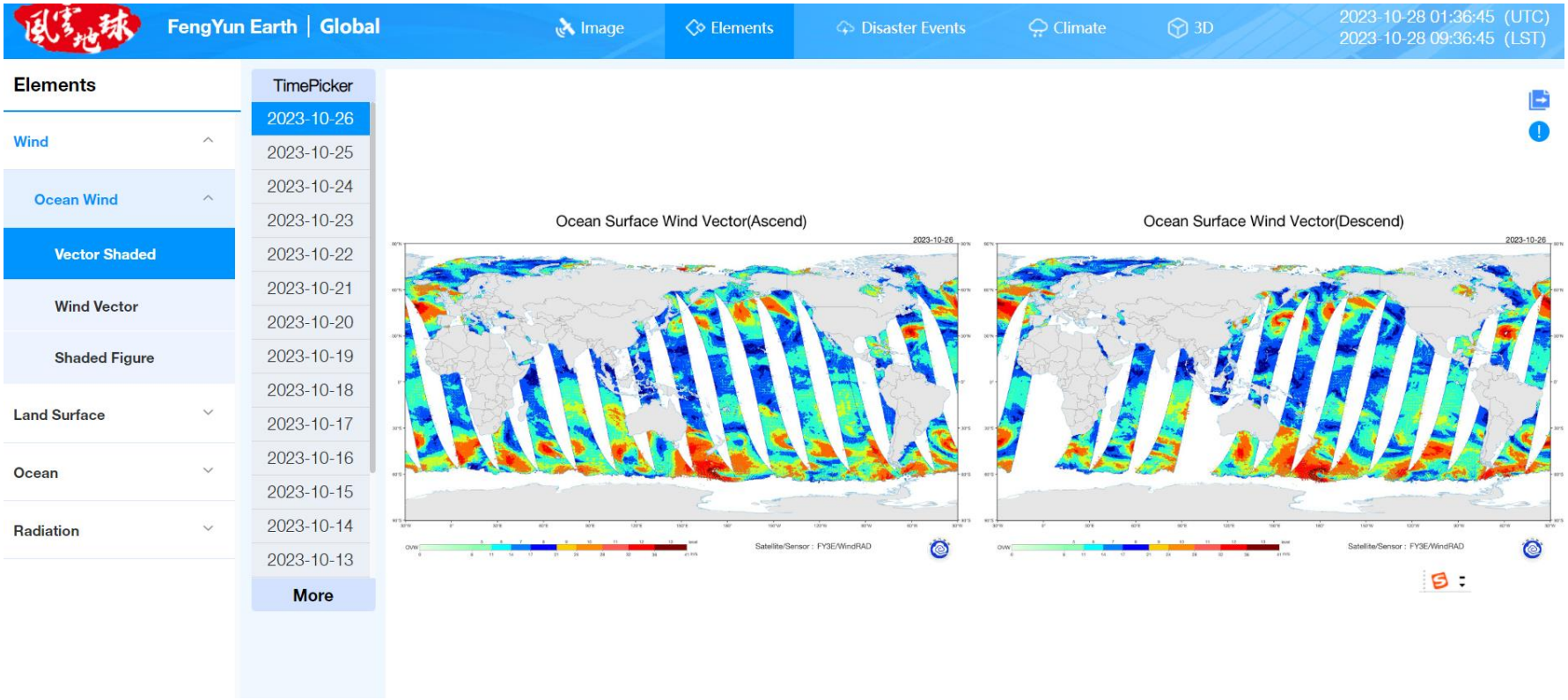




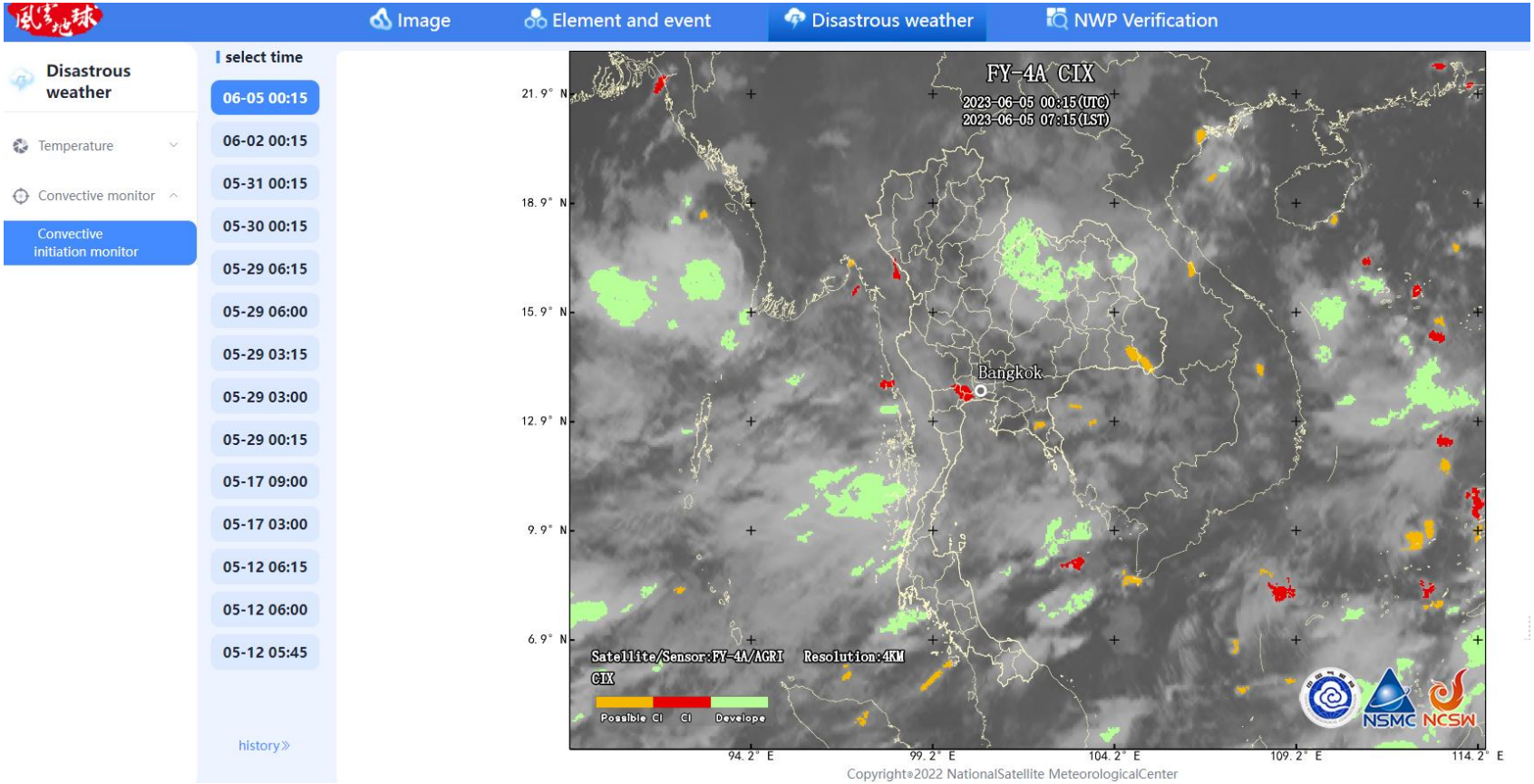
FengYun Earth -Product



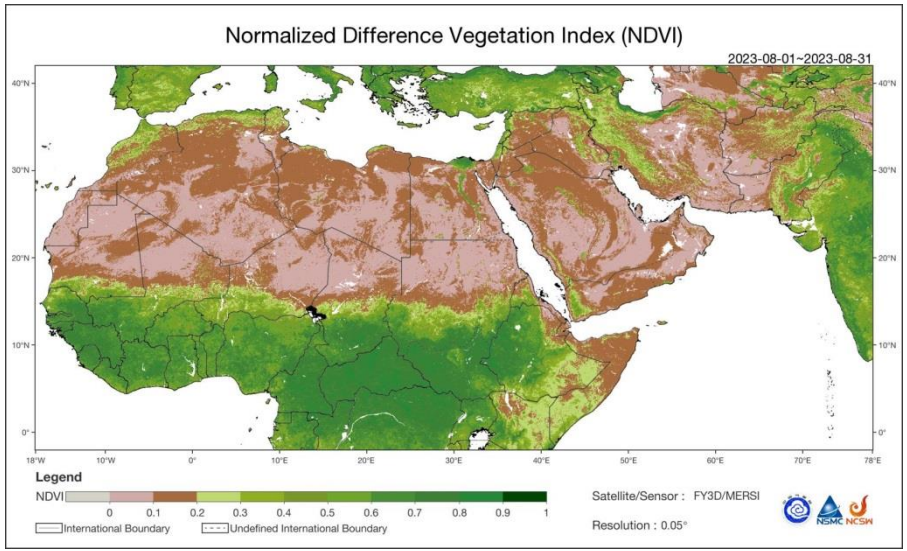
FengYun Earth -Product

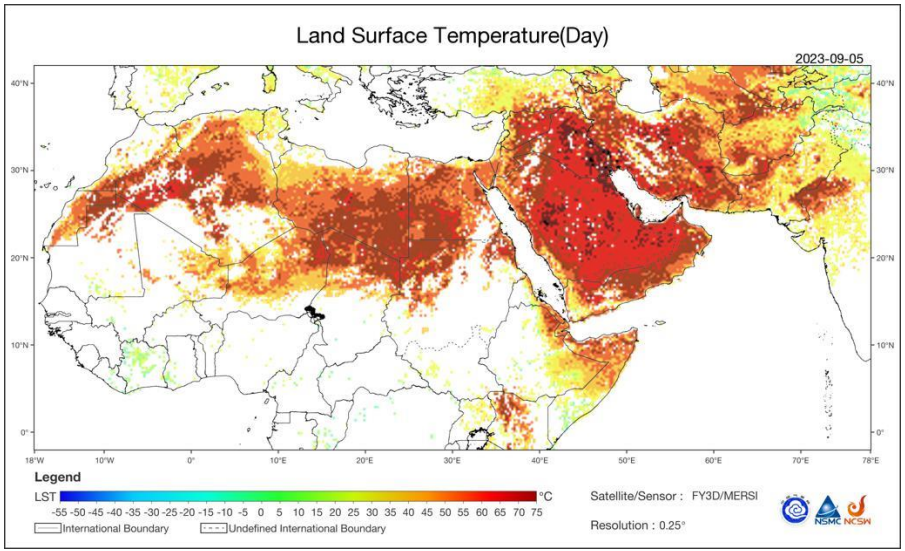


FengYun Earth -Product



FengYun Earth -Product





NDVI and Land Surface Temperature in Arab region

1. FENGYUN EARTH

2. SWAP

3. SMART

Platforms：SWAP

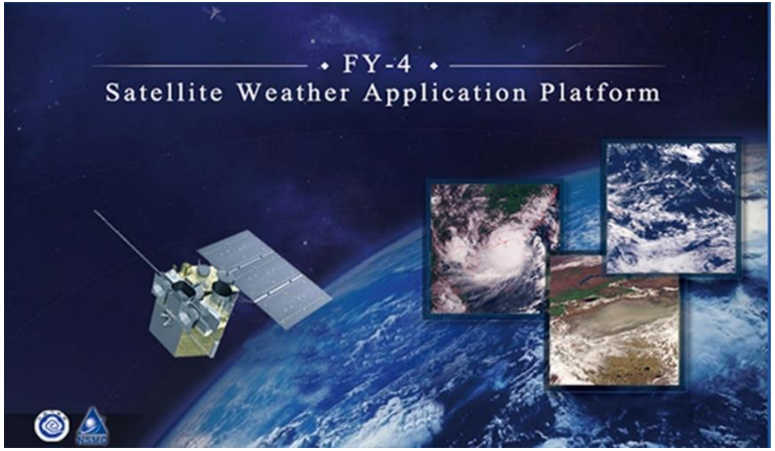
Weather monitoring and analysis---Geostationary Satellite data (FY-2/FY-4)

Platform for Geostationary Satellites

Main User: **Meteorologist**

Typical Applications: **Tropical cyclone, Convection, Sandstorm， Fire, etc.**

- SWAP Web version



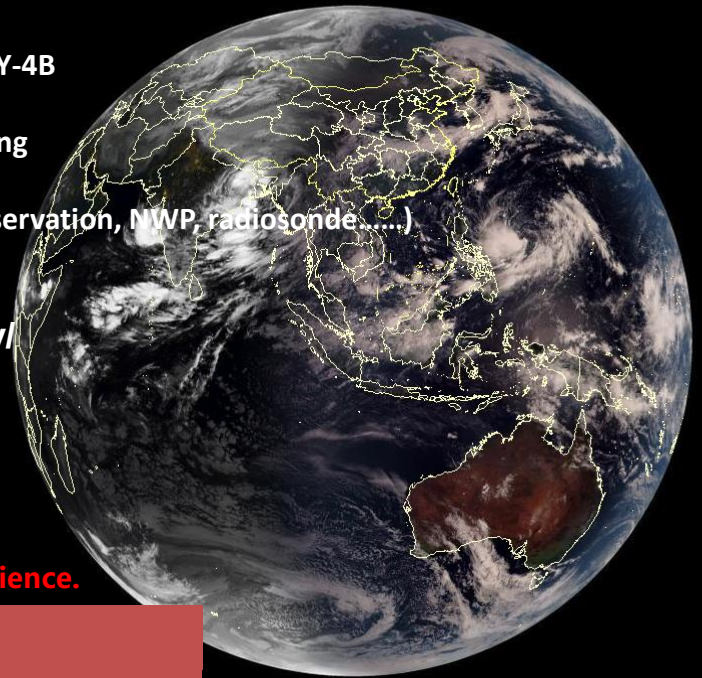
- SWAP Stand-alone version

Platforms： SWAP （web version）

Main functions

- Near real-time images of FY-2H , FY-4A, FY-4B
- 30+ GEO satellite products
- Special applications on weather forecasting
- Animation generation and sharing
- Multiple data analysis (radar, ground observation, NWP, radiosonde……)
- Data statistics

http://rsapp.nsmc.org.cn/test_geofy/



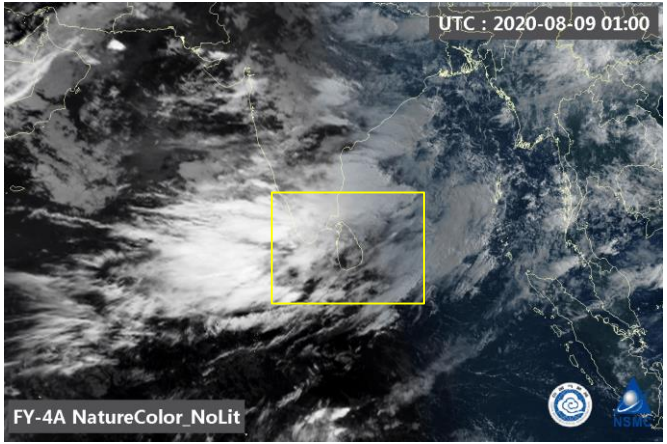
Chrome is recommended for best user experience.

Supportted browser:

IE 10+	Edge 18+	Chrome 26+	Safari 8+	Opera 18+
YES	YES	YES	YES	YES

SWAP-System Overview and features

SWAP has the ability of rendering single/multiple channel composites, and overlaying L2 products. SWAP is implemented with BS (Browser Service) architecture and accessed through web browser, users do not need to install extra software to access SWAP system.



Cloud based data access

- FY-4 satellite data access through data cloud, and performs automatic image tiling, publication, and update;
- SWAP has the ability of real-time rendering single/ multiple channel composites, and overlaying

Comprehensive satellite data visualization

- Animation play and control;
- Keyboard shortcut for each function;
- Rolling screen for product animation comparison;
- Transparency control for image layer;
- Show/hide control for image layer;
- Online customizable markers;
- Right mouse key one-click resolution toggle

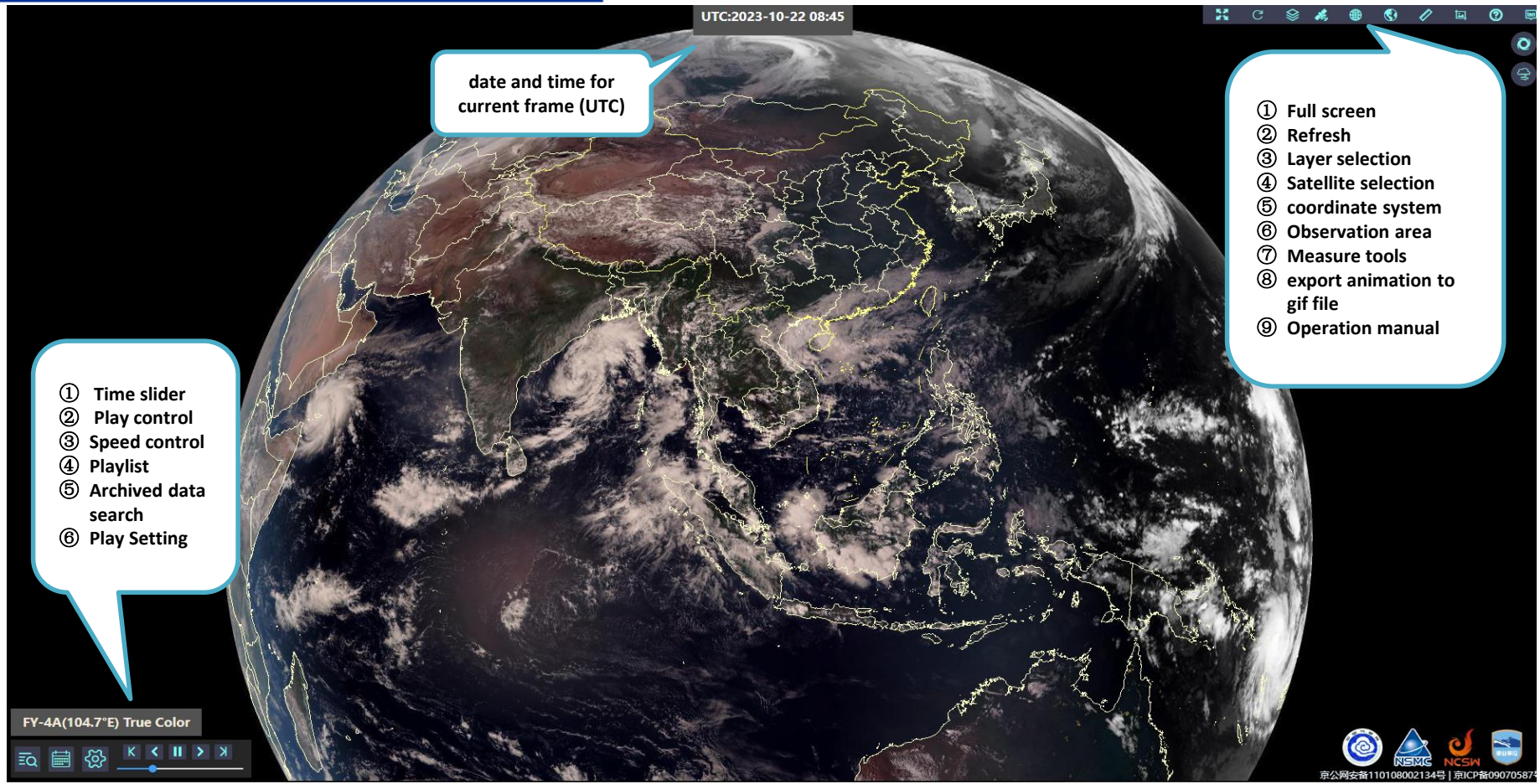
Online sharing of viewing window

- SWAP records current web page parameters, which enables online viewing window sharing
- After sharing web page link, user can resume current interactive status at any place 。

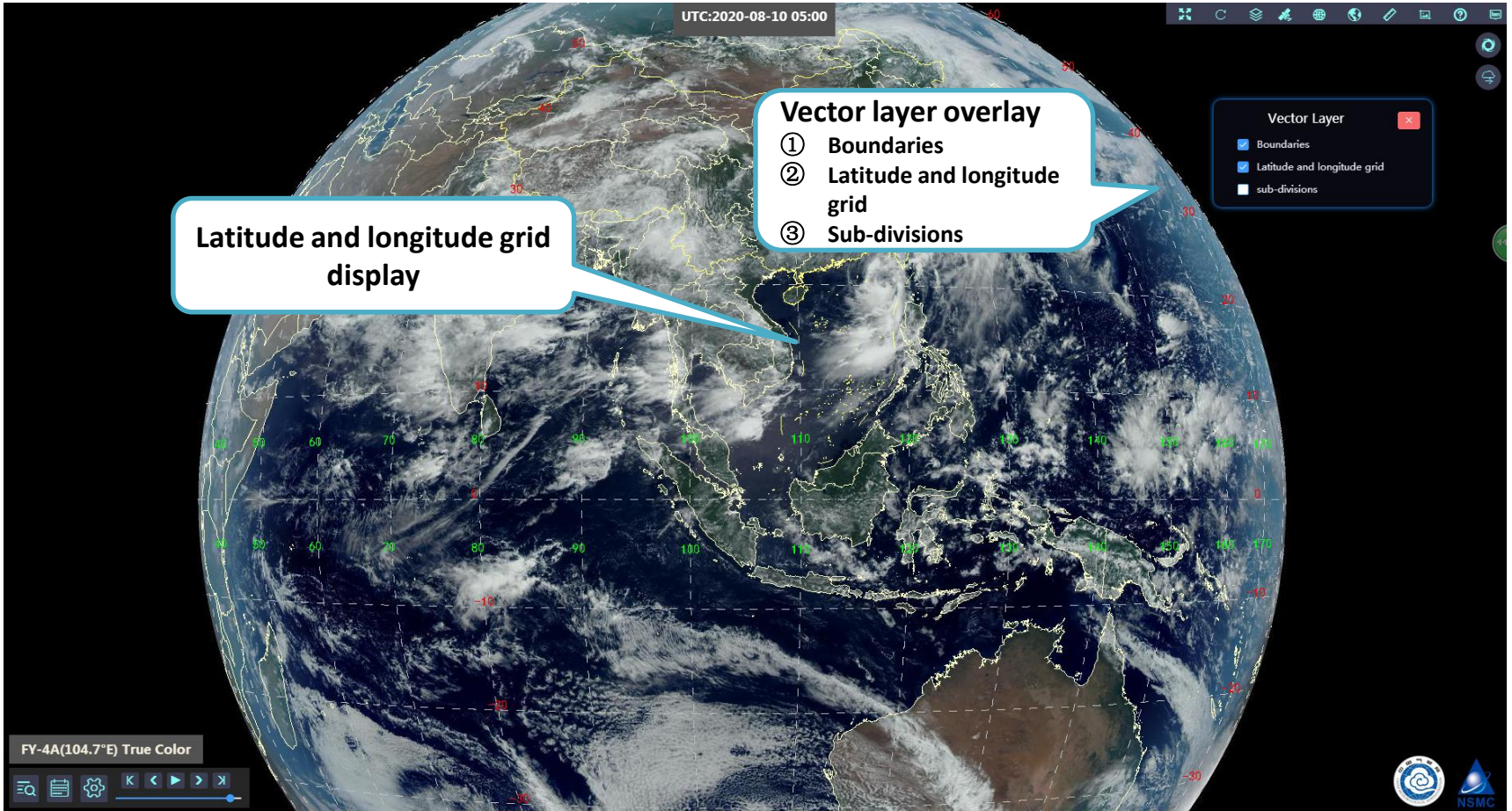
Cloud atlas animation export

- User can export current viewing animation area as gif file.;
- Progress bar will show the animation export progress. 。

SWAP Web version



SWAP： Vector Layer overlay

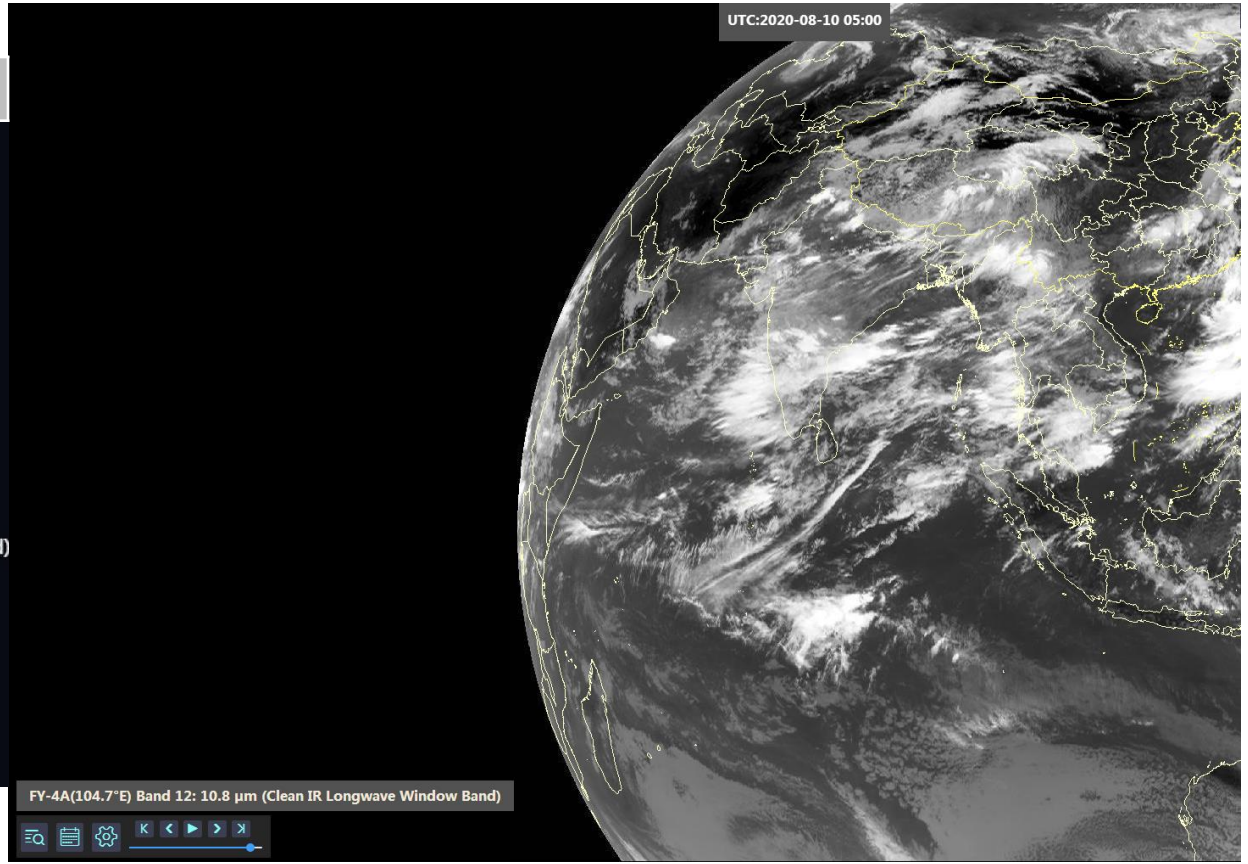


SWAP： Satellite channel view

SWAP FY4 Channel View

Satellite Band

- IR Enhance (From CIMSS)
- Band 1: 0.47 μm (blue Band)
- Band 2: 0.65 μm (Red Band)
- Band 3: 0.83 μm (Veggie Band)
- Band 4: 1.37 μm (Cirrus Band)
- Band 5: 1.61 μm (Snow/Ice Band)
- Band 6: 2.22 μm (Cloud Particle Size Band)
- Band 7: 3.72 μm (Shortwave Window Band High)
- Band 8: 3.72 μm (Shortwave Window Band Low)
- Band 9: 6.25 μm (Upper-Level Tropospheric Water Vapor Band)
- Band 10: 7.1 μm (Lower-level Water Vapor Band)
- Band 11: 8.5 μm (Cloud-Top Phase Band)
- Band 12: 10.8 μm (Clean IR Longwave Window Band)
- Band 13: 12μm (Dirty Longwave Window Band)
- Band 14: 13.5 μm (CO2 Longwave Infrared Band)

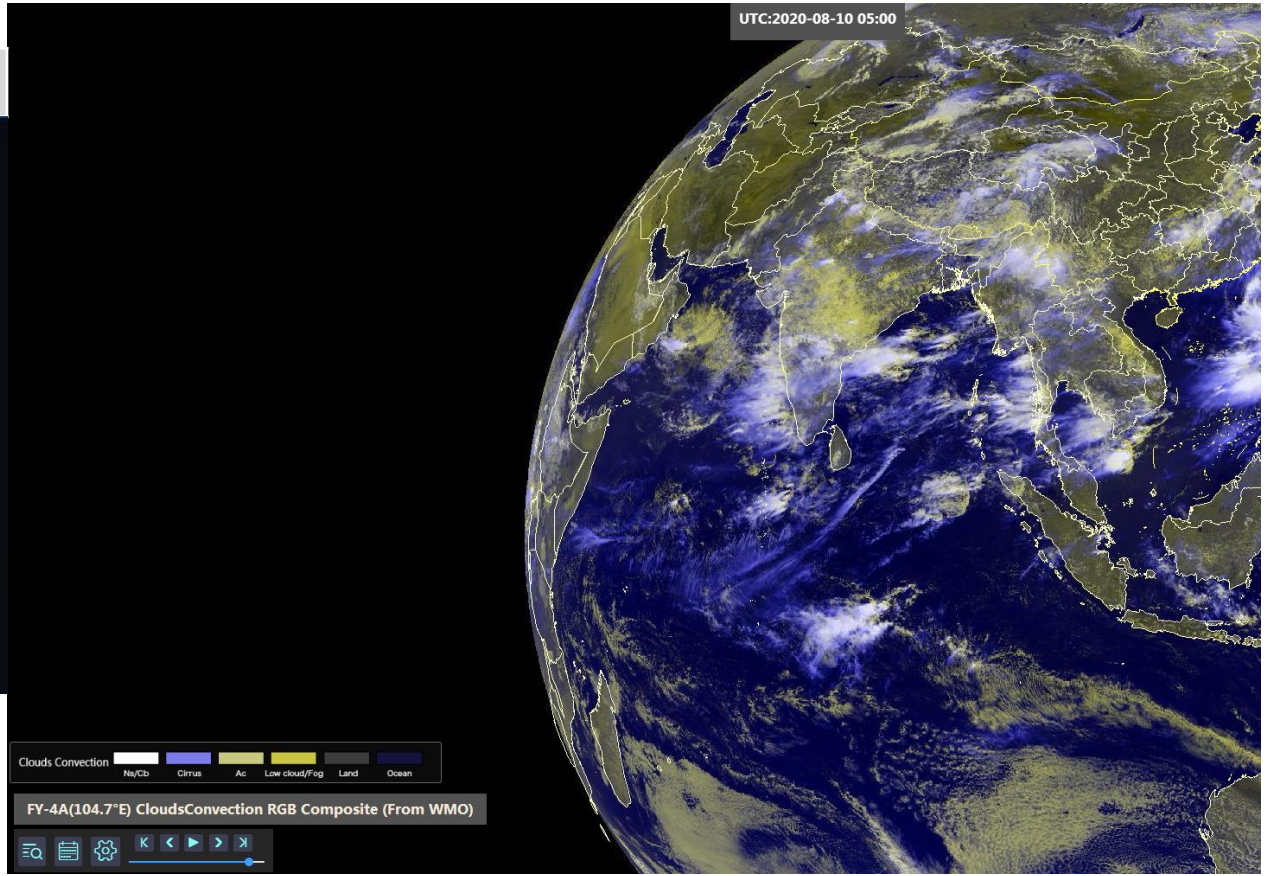


SWAP： Synthetics scheme

SWAP Support 12 Synthetics scheme

Synthetic scheme

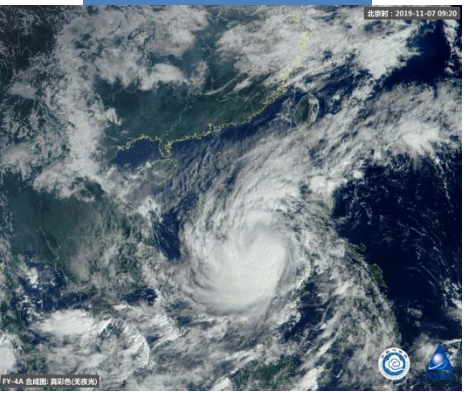
- NatureColor
- NatureColor_NoLit
- Natural Color RGB Composite (From WMO)
- Dust RGB Composite (From WMO)
- AirMass RGB Composite (From WMO)
- Fog/Snow RGB Composite (From WMO)
- Severe Storms RGB Composite (From WMO)
- CloudsConvection RGB Composite (From WMO)
- Volcanic Ash RGB Composite (From WMO)
- Day Convective Storms RGB Composite (From WMO)
- Day Microphysics RGB Composite (From WMO)
- Night Microphysics RGB Composite (From WMO)



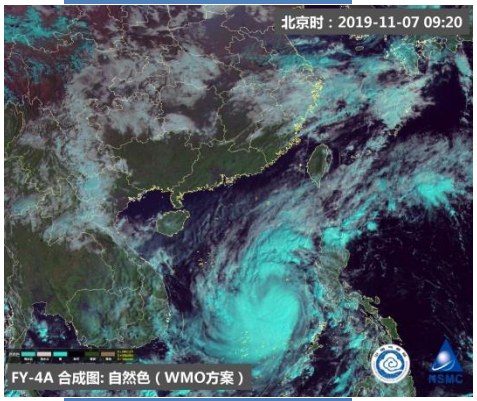
SWAP

Examples of RGB composite products

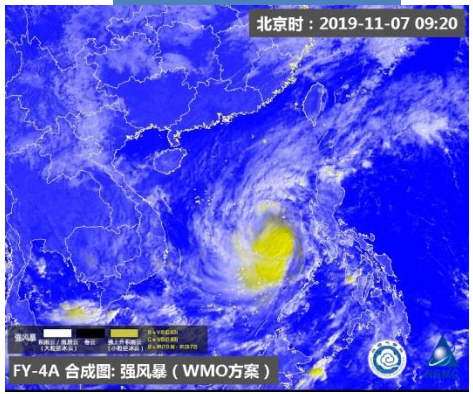
true colors



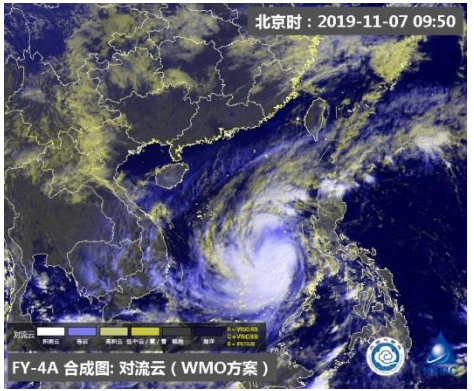
natural colors



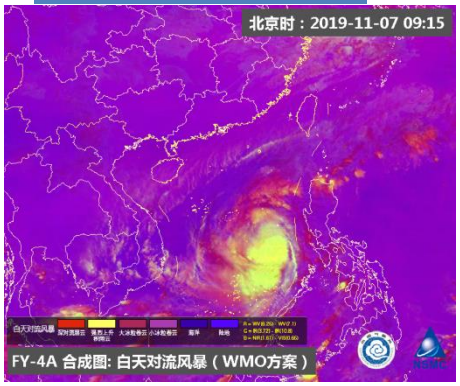
Severe storms



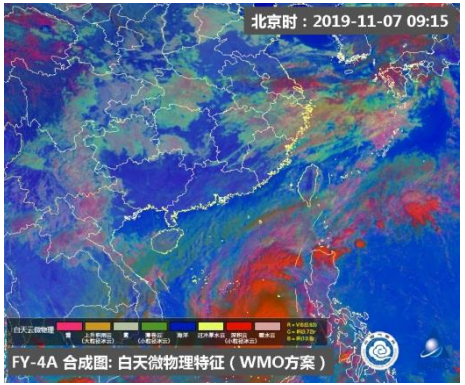
clouds convection



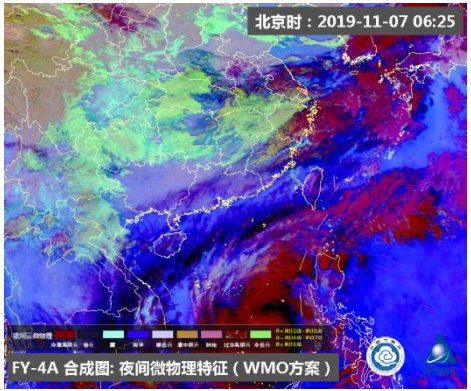
day convective storms



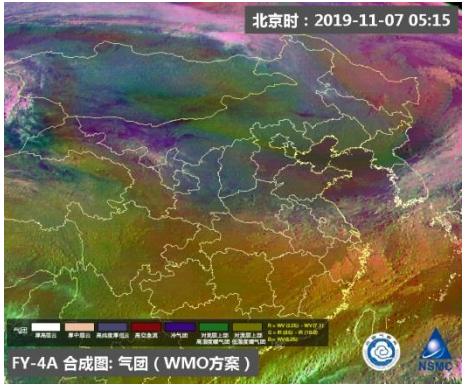
day microphysics



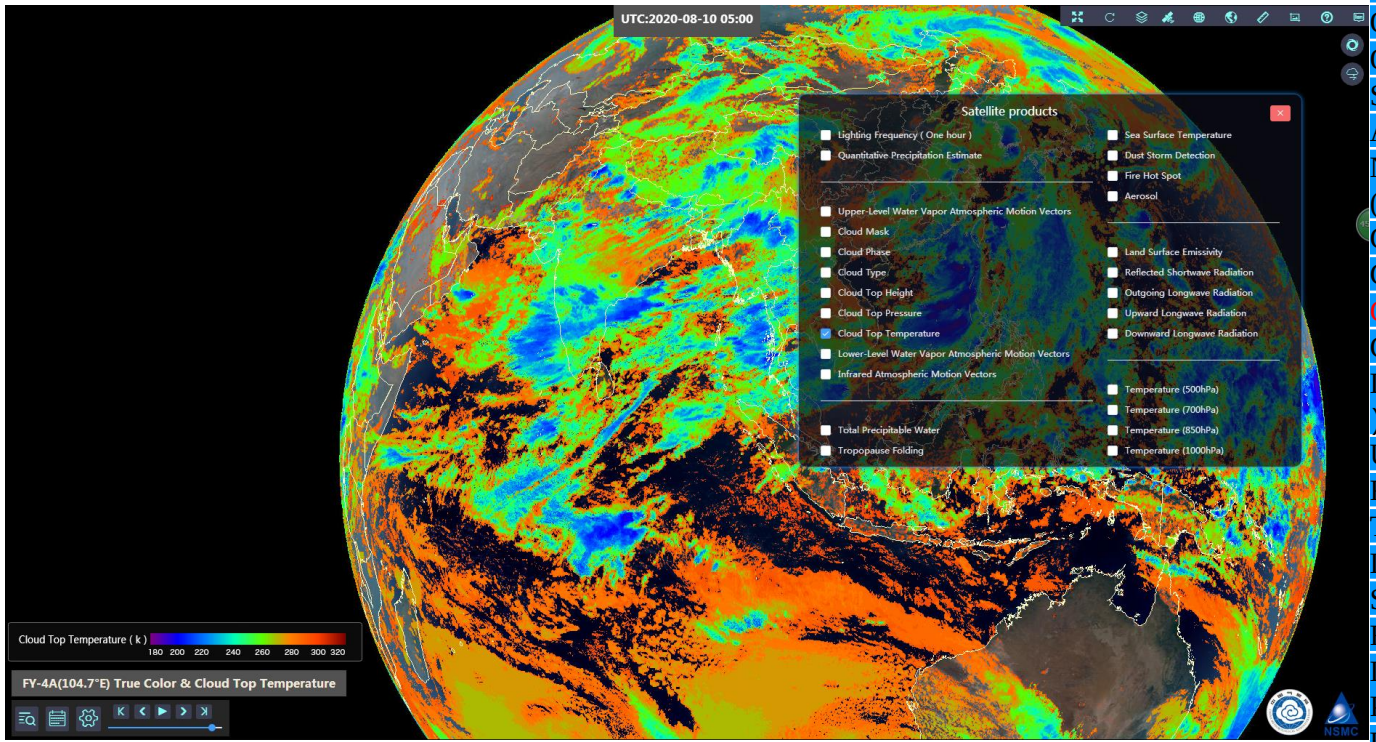
Night microphysics



air mass

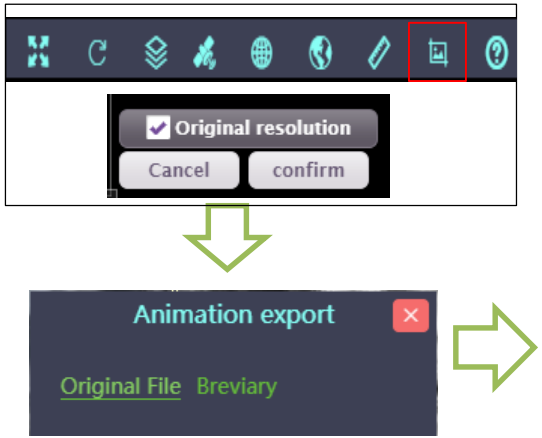


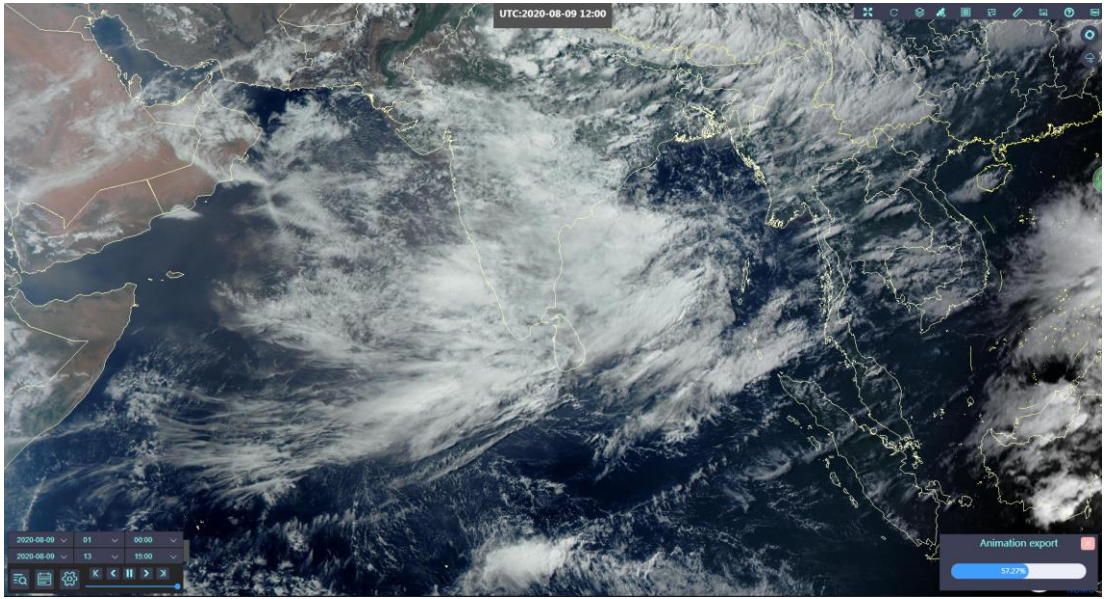
SWAP： Satellite product overlay



SWAP Support 30+ Products
Cloud Mask
Cloud Type
Dust Storm Detection
Outgoing Longwave Radiation
Quantitative Precipitation Estimate
Surface Solar Irradiance
Atmospheric Vertical Profile
Number of Lightning Events (Count/min)
Cloud Phase
Cloud Top Height
Cloud Top Temperature
Cloud Top Pressure
Downward Longwave Radiation （DLR）
Upward Longwave Radiation （ULR）
Reflected Shortwave Radiation （RSR）
Tropopause Folding
Land Surface Emissivity
Sea Surface Temperature
Fire Hot Spot
Layer Precipitable Water (Contain Total Precipitable Water)
Upper-Level Water Vapor Atmospheric Motion Vectors
Convective Initiation

SWAP : Animation export

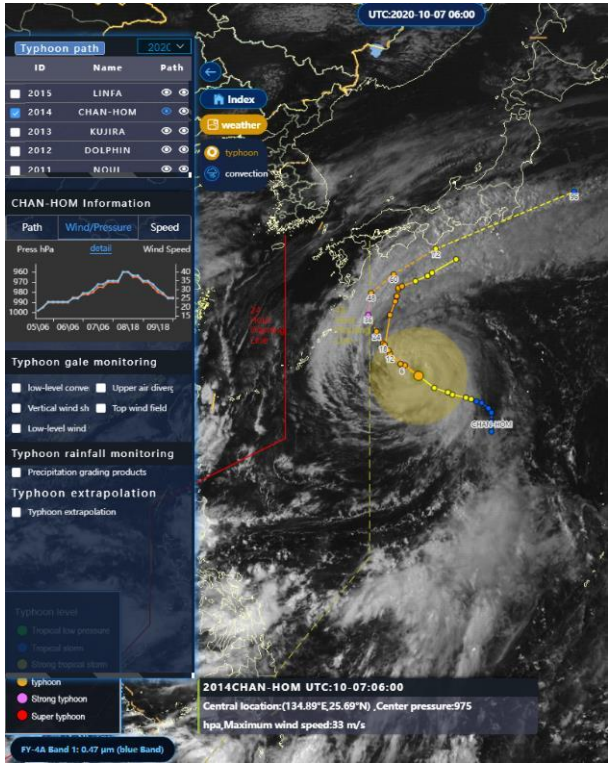




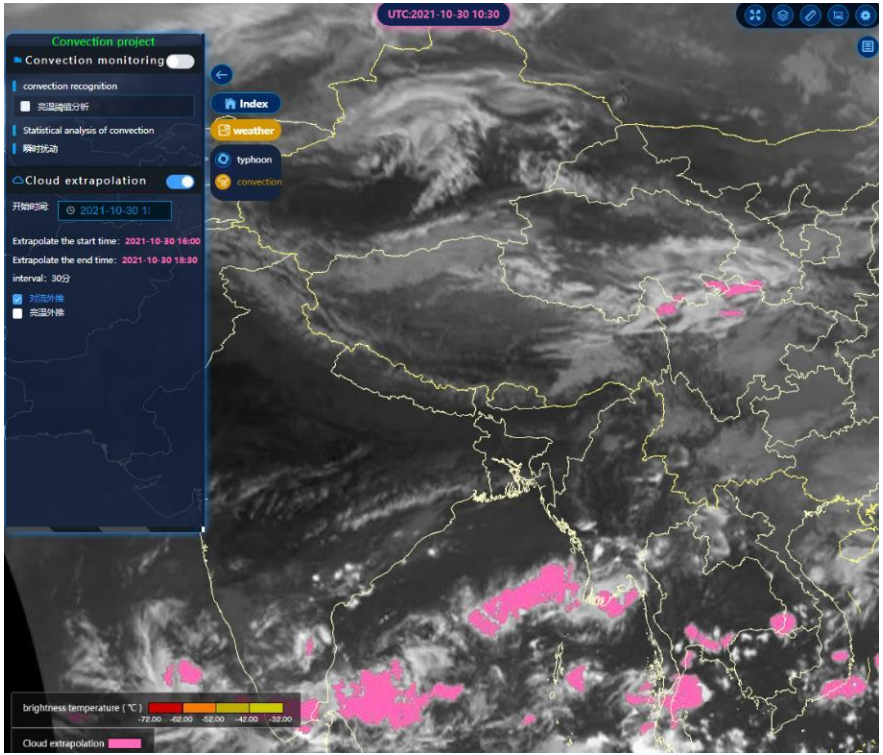
http://rsapp.nsmc.org.cn/FY4A/exp_gif/20200810/1597048891753_11_1.gif

SWAP : analysis

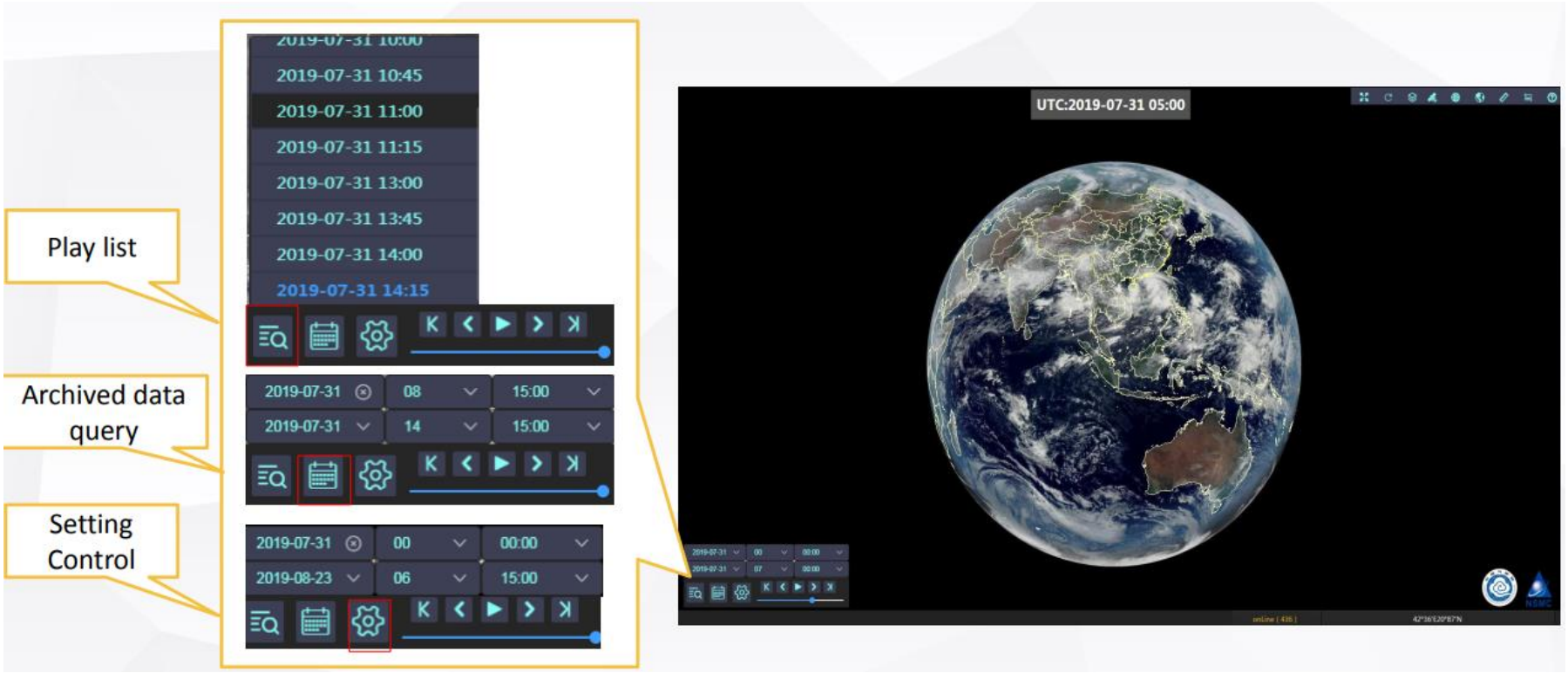
Typhoon analysis



Convective analysis and forecast



SWAP : Archiving images



SWAP(stand-alone version) -features

SWAP stand-alone version can support provincial CMACast default folder structure, and support Provincial direct receiving station data format. and support Custom data access. And support System file selector and manual file selection. Realizing comprehensive display of FY-4A and FY-2 series satellite data, interactive typhoon positioning / intensity estimation, and strong convective system analysis. Displaying L1 data, compositing multiple channel data, playing animation, rendering L2 data, etc.

Data Access

- Provincial CMACast default folder structure support
- Provincial direct receiving station HRIT format support
- Custom data access with configuration file
- System file selector and manual file selection support

Comprehensive FY4 and FY2 satellite data display

- Nominal geostationary satellite coordinate system support
- Single-frame cloud atlas and multi-frame animation support
- Flexible channel toggle and layer management
- Single channel pseudo-color enhancement with specific color map
- L2 data overlay display
- Cloud atlas animation file export
- FY-4A true color composite

Thematic application

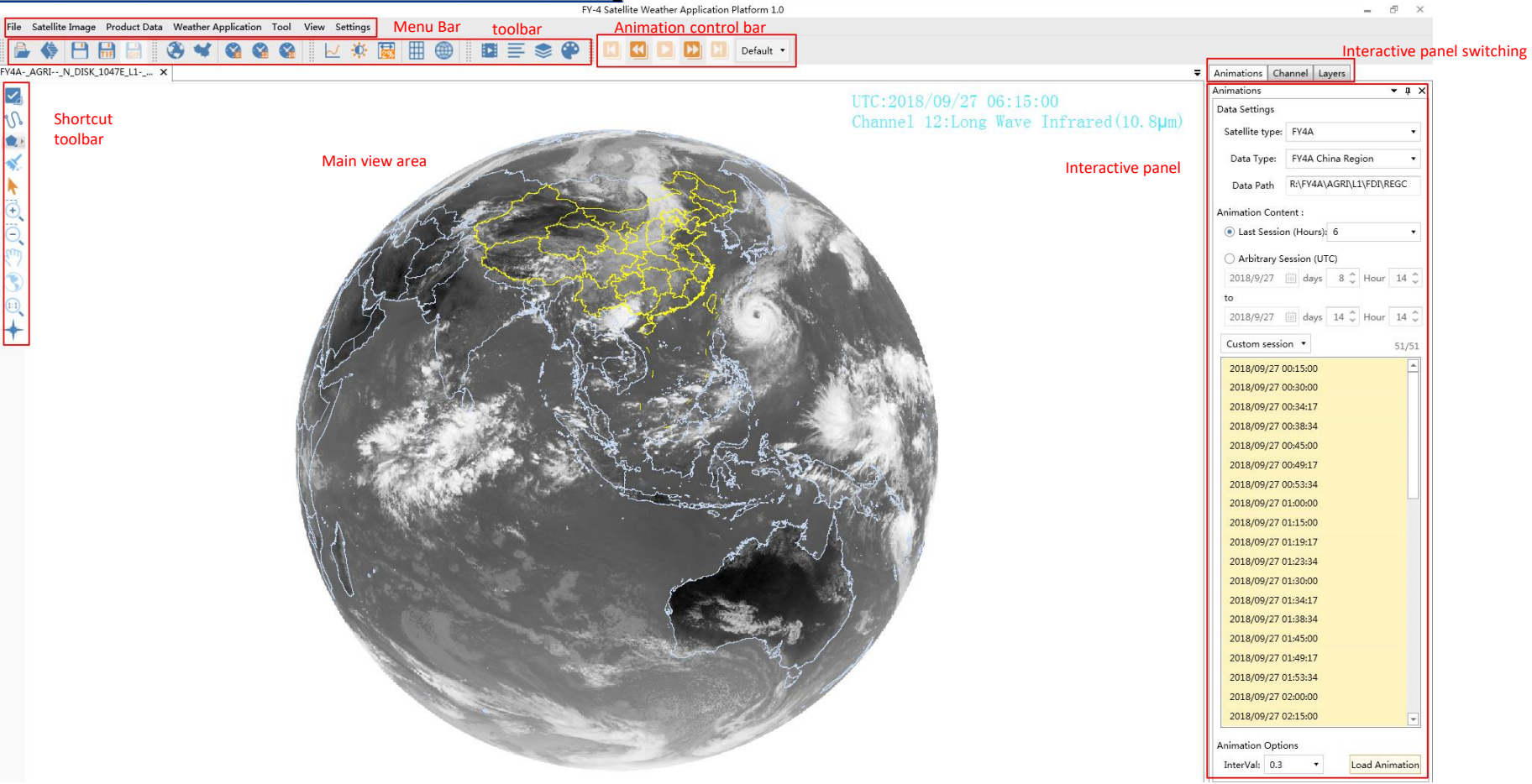
Strong convective system interactive analysis

- Default and manual ROI selection
- Interactive parameter configuration, real time analysis result display

Cyclone positioning and intensity estimation

- Pixel level positioning and inverse positioning based on cloud atlas
- Interactive point selection and spiral fitting
- Spiral parameter adjustment

SWAP Interface layout



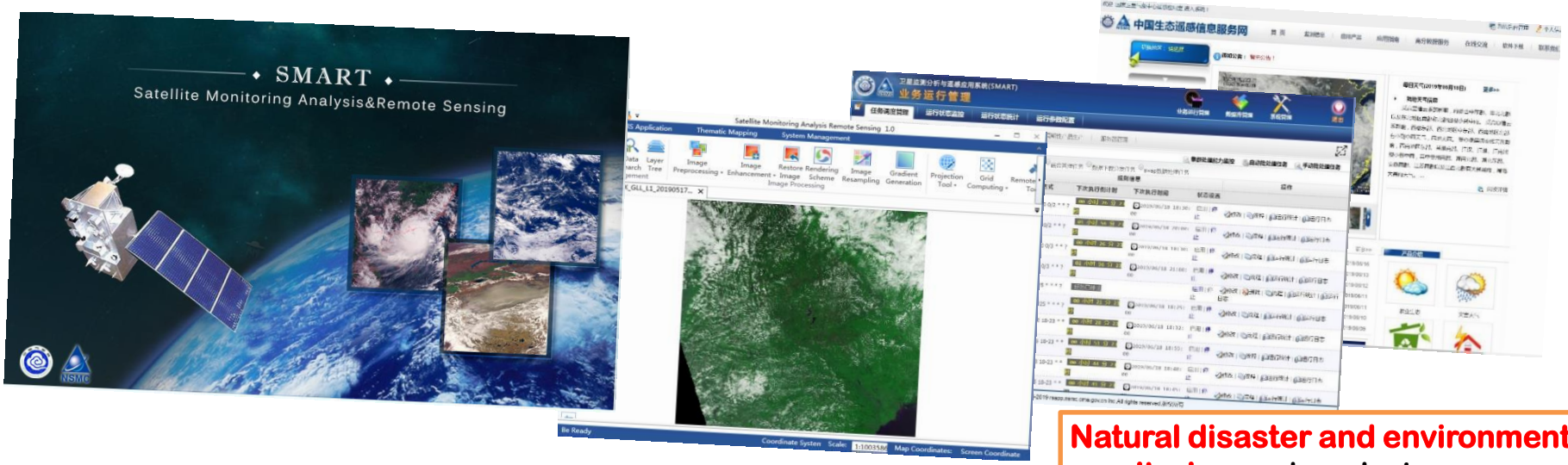
1. FENGYUN EARTH

2. SWAP

3. SMART

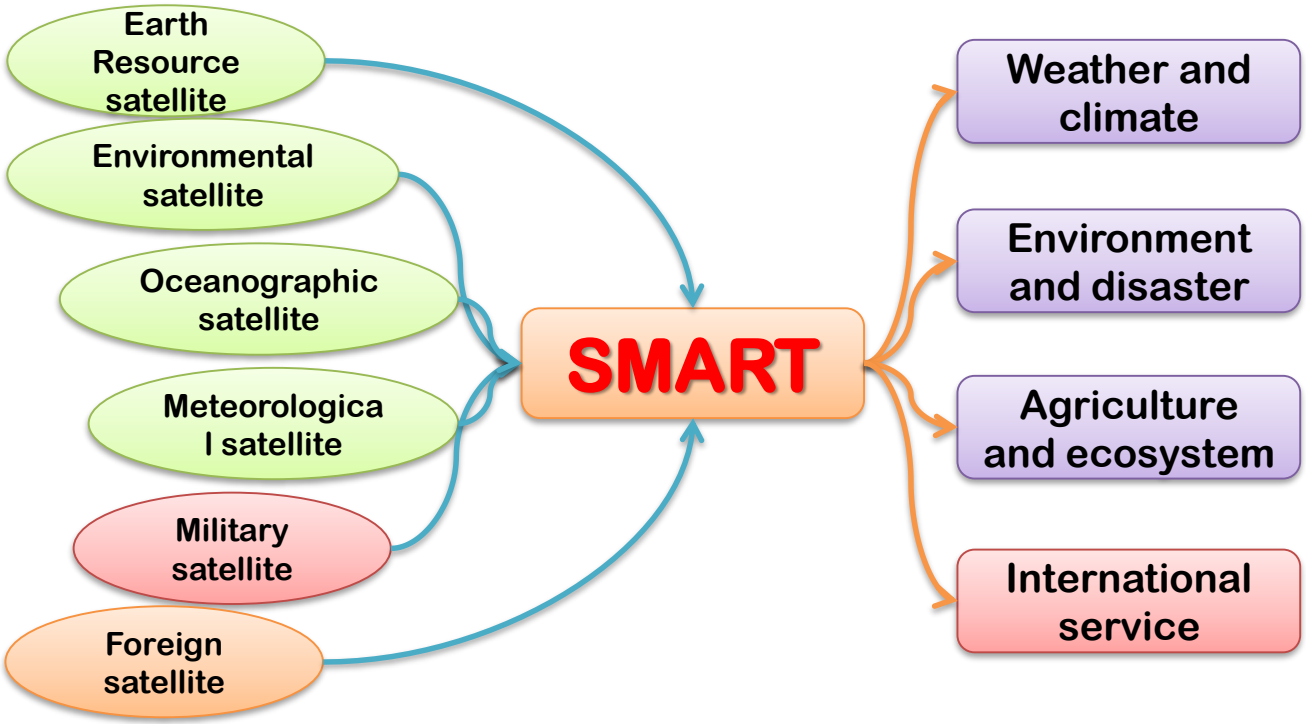
SMART

SMART(Satellite Monitoring Analysis & Remote sensing Toolkit) is a general application platform developed by NSMC that offers fY-3-based monitoring outputs, data analyses and public services. It is a comprehensive application platform for remote sensing monitoring and application using FY-3 and other meteorological satellite Data.



Natural disaster and environment monitoring and analysis
---polar orbit Satellite data

SMART

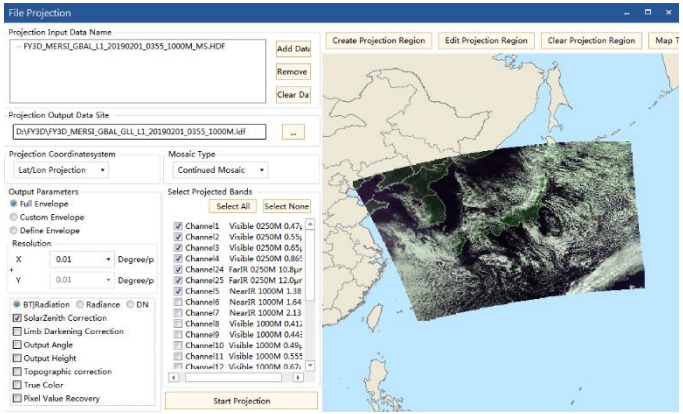


Multi-satellites Supporting

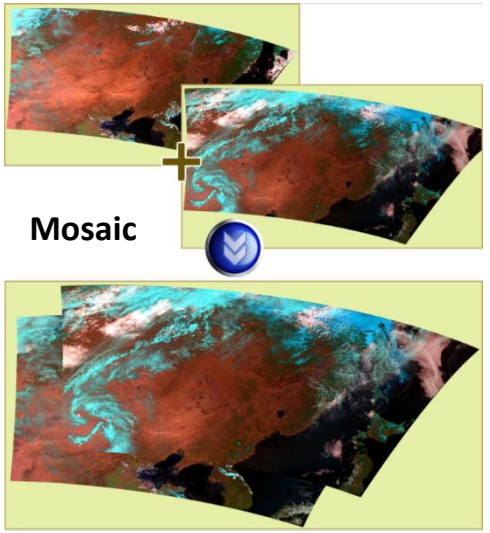
SMART-Main Functions

Tools of RS Data Processing

Monitoring & analysis system realizes many remote sensing processing functions , such as radiometric correction, projection, projection and coordinate system conversion, mosaic, resize, geometrical correction, True & Pseudo color composite, vector to raster, raster to vector, density slicing, texture feature extraction etc.



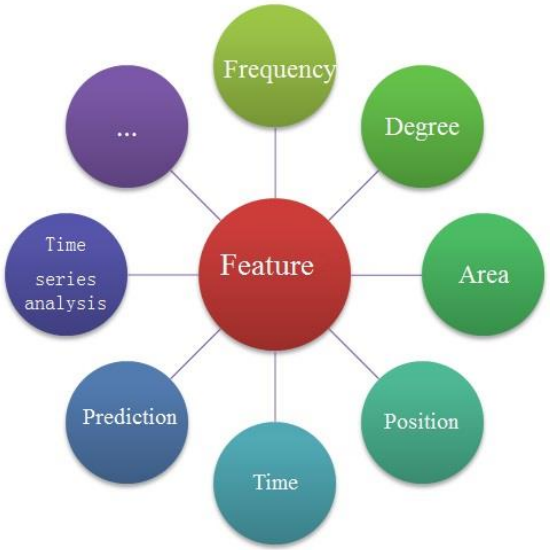
Projection



SMART-Main Functions

Monitoring & Analyzing Thematic Products

Monitoring & Analyzing Thematic Products



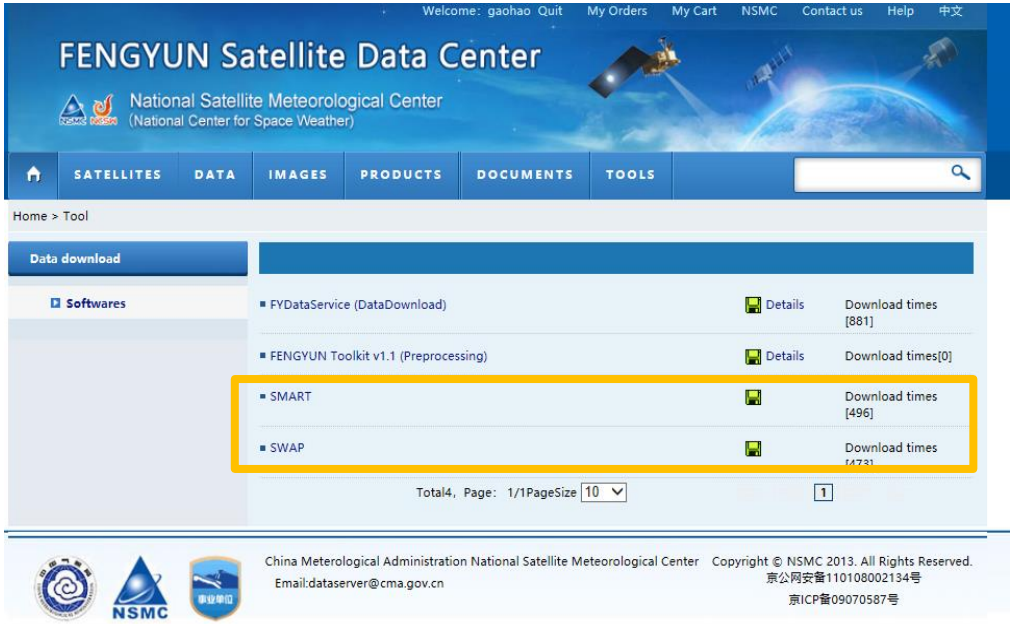
- Dust
- Fog
- Fire
- Water
- Snow
- Sea ice
- Cyanophyta
- Vegetation
- Drought
- Land surface temperature
- Urban Heat Island
- Extension of new production

Monitoring analysis content：

- Frequency
- Administrative region
- Area
- Location
- Time
- Changes
- ……

Data Application Tools

Users can login to www.nsmc.org.cn/en/ to download the FY Satellite Weather Application Platform (SWAP) and the FY Satellite Environmental and Ecological Monitoring System (SMART) to process and display FY satellite data.



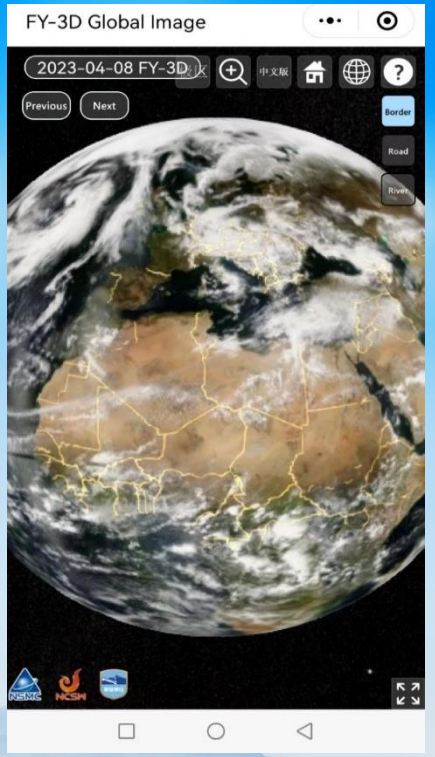
SWAP & SMART

http://www.nsmc.org.cn/service/en/emergency/tools.html

Mobility applications -WeChat apple

FY-4B full disk

FY-4B live video



CONTENTS

International Communication and Cooperation

WMO

CGMS

GEO

CEOS

APSCO

ICAO

International Organization

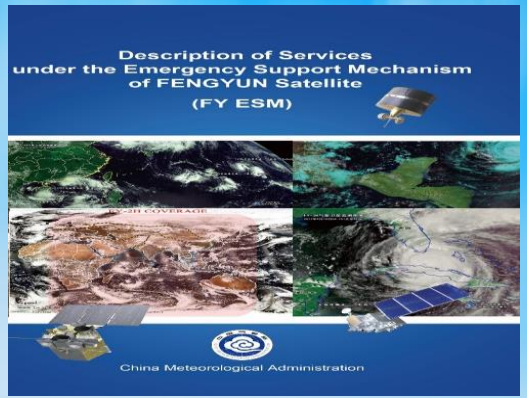
Meteorological Satellite Operator

CMA-
EUMETSAT

FengYun Satellite Service for “Belt & Road”

Data Receiving Equipment Handover in Malaysia

FY-2H DB Station Installation in Bangladesh



- FY_ESM: 32 countries.
- Emergency support for 45 countries, 96 times from 2018, including FY_ESM, UN-SPIDER, CHARTER, etc.

32 Countries

Laos, Myanmar, Iran, Maldives, Thailand, Philippines, Algeria, Malaysia, Uzbekistan, Tunisia, Mongolia, Nepal, New Zealand, Oman, Mozambique, Kyrgyzstan, Kingdom of Lesotho, Nigeria, Ethiopia, Guinea, Benin, Mauritius, Ghana, Portugal, Malawi, Armenia, Sri Lanka, Solomon Islands, Vanuatu Papua New Guinea, Pakistan, Côte d'Ivoire

CONTENTS

FY Satellite Services for Sustainable Development

- Bilateral and international data exchange
- Give helps on DB and CMACast data receiving
- Built a data sharing service based on public cloud
- Increase data and products

- Strengthen cooperation with Vlab
- Training courses on FY application and data usage

- Improve platforms based on GEO and LEO data face to Asia-Oceania area and Global observation
- Provide useful software and toolkit

- Bilateral and international scientific cooperation on weather, climate change and environment detection, etc.
- Built virtual scientific research community

- Strengthen cooperation on FY_ESM
- Increase response data and products

http://sac347.nsmc.org.cn/nsmc/en/home/index.html

The purpose of the conference is to establish a platform for international users of FengYun satellites, facilitating in-depth discussions regarding their applications and requirements, promoting the global integrated application of FengYun satellites to achieve maximum benefits across various application areas, and mitigating the impacts of hazardous weather, water, or climate events.

Future Plan


FY-3H(PM)
2024
FY-3I(RF)
2027
FY-3J(EM)
2028
FY-5
203X
FY-4C
2024
FY-4M(MW)
2025
FY-4D
2027
FY-4E
2029
FY-6
203X
SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Useful links to FY satellite data and applications

- Nation Satellite Meteorological Center: http://www.nsmc.org.cn/en
- FENGYUN satellite data center: http://data.nsmc.org.cn
- FENGYUN Earth: http://fyearth.nsmc.org.cn/
- FENGYUN satellite data ftp server (user account required): ftp://ftp.nsmc.org.cn
- FENGYUN satellite data analysis platform: http://rsapp.nsmc.org.cn/geofy/en/
- FY-4A animation: http://fy4.nsmc.org.cn/portal/en/theme/FY4A.html
- SWAP2.0 (English): http://rsapp.nsmc.org.cn/geofy/en
- SWAP2.0 test version (English): http://rsapp.nsmc.org.cn/test_geofy/en
- FY-3 Global Daily Image: https://fy4.nsmc.org.cn/mips/index.html

Thanks for listening!

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